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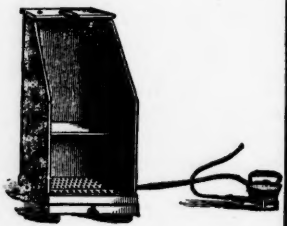

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THE

JOURNAL OF SCIENCE.

FEBRUARY, 1885.

I. THE LESSONS OF THE "MIGNONETTE" CASE.

MODERN researches on brain-diseases—whether temporary or persistent, functional or organic—have led to results which the moralist and the legist, however reluctantly, will find themselves bound to consider. "Reluctantly," we say, because such consideration cannot fail to invalidate some of the dogmas of the former and to scatter the precedents of the latter.

Setting aside certain palæozoïc writers who still view insanity not as disease, but as sin, and in itself worthy of penalties, we find amongst all who examine the subject a full consent. All agree that the man "out of his mind" cannot be treated as either morally or legally responsible for his actions. If such a man commits any crime he cannot, it is admitted, be condemned and punished like a sane man, though the public safety demands that he shall be placed where he can injure neither himself nor anyone else.

This principle, universally admitted in civilised countries, is carried into practice in various ways. In England the trial of the accused begins in the ordinary fashion, but his counsel raises the plea of insanity. If this plea is established by the evidence of the medical experts called, the judge directs a verdict of "Not guilty" to be entered, and the prisoner is sentenced to be placed in confinement during Her Majesty's pleasure. Sometimes it may happen that sentence—say of death—is passed in the ordinary form, but

an application for commutation of sentence is made afterwards on the ground of alleged insanity.

Perhaps it would be preferable if, in all cases where the mental soundness of an accused person admits of doubt, a distinct and preliminary investigation of this point were first made, putting him formally on his trial only if adjudged rational.

But whilst so far all men are agreed there is a wonderful divergence of opinion when we ask who are to be adjudged irresponsible as insane? Are we to confine this exemption to persons who are uniformly and persistently deranged for some considerable time, or who are manifestly irrational upon all subjects? Or are we, as some propose, to extend it to persons who have, as it is asserted, a short and sudden fit of madness, during which they act in a manner quite contrary to their normal character, and of which they remember nothing when—perhaps after the lapse of a few hours—they recover their full consciousness? Here, surely, we are on very dangerous ground, where to lay down any hard-and-fast line becomes impracticable. Among these difficult cases ranks that of the drunkard. The law of England, as repeatedly declared from the Bench, declares that intoxication is no excuse for any crime, since the offender—if for the time being "demented"—is so by his own act and deed. Nevertheless drunkenness is constantly pleaded in defence or in extenuation, not merely by prisoners but by their advocates, and rarely, very rarely indeed, does any severe rebuke fall to the lot of either.

In America, however, it has been formally proposed that a criminal should be regarded as irresponsible, and consequently not to be punished, if it appear that he was drunk at the time when the offence was committed. Some writers have even gone further, and have contended that the state of degeneration, intellectual and moral, to which a man may be brought by the free use of alcohol, and indeed of a variety of narcotics, should likewise be received as a valid plea on behalf of persons accused of murder, incendiarism, forgery, &c.

No one will, of course, deny that a drunkard is for the time being insane; nor can we refuse to admit that the habitual alcoholist, even when not actually drunk, may lose to a great extent, and at times, the power of distinguishing between right and wrong, between lawful and unlawful. Still, without self-anticipation, we may remark that considerations of public safety prohibit the admission of these pleas.

But there is one agency which may derange the mind, intellectually and morally, in degrees varying progressively from a mere evil temper up to raving madness, and which must and will, in its more advanced stages, be regarded as rendering persons brought under its influence for the time being irresponsible. This agency is hunger, in anything beyond the degree in which it ensures a healthy appetite. To this agency public attention has been lately drawn by the case of the *Mignonette*,—lamentable in itself, and surely not less lamentable as to the way in which it has been treated by the highest judicial authorities in this self-styled enlightened age and country.

If we consider the effects of hunger we shall find that, even in a very moderate degree, it renders men eminently morose and cantankerous. Everyone can testify as to the impolicy of asking any man for a favour, or even for an act of simple justice, shortly before lunch or dinner, as the case may be.

But instead of a man in normal health, who knows that a meal awaits him at the usual time, let us take that of a man who even voluntarily abstains from food for an entire day, or takes for a longer time nourishment in merely homœopathic doses. As instances may serve the Russian peasant during his strict Lent, and the Turk during his Ramadan. It is difficult to imagine the degree of "envy, hatred, malice, and all uncharitableness" which at this time prevails. Suffice it to say that assassinations and malicious injury to persons and property are far more common, to an extent statistically recognised, than in any other portion of the year of equal length. It may not be considered a digression if we point to the absurdity of recognising fasts as a means of moral and religious discipline, when their demoralising effects are so clearly manifest.

We may go a step further: of all mortals the most malignant to their fellows are the ascetics, of all creeds, with whom fasts are interrupted only by insufficient food. With these men we find not merely the moral sense perverted, but the intellect is manifestly deranged. They see strange visions; they hear strange voices, and receive supernatural injunctions to deeds of cruelty.

We may perhaps here be permitted to refer to an experience of our youth. Making a pedestrian tour along with two friends, in a beautiful but very thinly-peopled country, we crossed a mountain ridge at a wrong point, and entered a region perfectly desert, where for at least thirty-six hours no food was procurable. We were so hungry that we could

have eaten even an Anti-Vivisectionist had he fallen in our way. But the most prominent point was the alteration which came over our dispositions. The one theme of conversation was vicious recrimination, and the attempt to saddle each other with the blame of losing our way. As the second day wore on we all began to see, or fancy we saw, non-existent objects, which vanished or took other changes as we drew nearer. Thus there was full proof that we were experiencing a temporary derangement, both intellectual and moral. Yet we had advantages which the crew of the *Mignonette* had not. Every few hundred yards brought us to a spring of the purest water. More than all, we were in no fear of perishing. We knew that by following the valley into which we had strayed we must shortly reach an inhabited region. This was not the case with the survivors of the *Mignonette*'s crew: they did not know whether they should meet with help in time; and this very uncertainty is the most distressing, in fact the maddening, element of the case. Privations endured voluntarily, and which must shortly come to an end, may be borne far more easily than those where a fatal issue is the more probable. The fasting Russian or Turk, the ascetic monk, hermit, or fakir, has each the same sustaining reflection. He knows that food is procurable if he finds it impossible to prolong his abstinence any further.

We have further evidence of positive madness setting in, in its most frightful forms, after long-continued inanition. Relief has in recorded cases come too late.

Seeing thus the psychical effects of starvation, we may well ask with what faintest show of reason men in such a state can be held legally responsible for their actions? They are at the time being simply mad, their nervous systems having entered upon a process which must be viewed as decomposition. It is idle to talk about "temptation" which was no "excuse." A sane man may resist "temptation," but it is not within the power of the maniac.

It is perfectly possible that Lord Chief Justice Coleridge may not be aware of the *modus operandi* of starvation. It is likewise possible that had the truth been laid before him he might have refused to recognise it as coming from his enemies, the physiologists. But we might have expected that Mr. Justice Grove—himself a man of Science—would not have concurred in the judgment, and would at least have saved the intellectual honour of the Court from question.

We have now to look at the *à fortiori* argument in virtue

of which these unfortunate men should have been pitied rather than blamed. The madman is not, in our times, put to death even for murder. A like exemption, as mentioned above, is proposed in America for the inebriate and for the chronic alcoholist. The former is, indeed, with us liable to safe-keeping for life. But wherefore? Because in a paroxysm of madness, which might occur at any moment, he might repeat the offence. We refuse to accept drunkenness as an excuse for the criminal, since every ruffian might plead drunkenness, or indeed, as often happens, might prime himself for the outrage with a dose of some intoxicant; but in the case of these unhappy cannibals on compulsion there is no fear of the deed of horror being repeated. The chances are doubtless millions to one against their being ever again placed in the same position. As utterly inconceivable is it that anyone would ever by semi-starvation qualify himself for committing murder with impunity. Whilst therefore these men were at the time being insane, and as such had a claim to be held free from responsibility, that insanity is not of a permanent or a recurrent type.

It becomes, therefore, difficult to conceive any sound reason for their punishment. To eliminate a public danger? Certainly not: under any normal circumstances these poor sailors, for anything that appears to the contrary, are no more likely to indulge in murder and cannibalism than Lord Coleridge himself. For their reformation? This end could not of course be effected by the death sentence nominally passed upon them, were it not absurd to speak of the further "reformation" of a madman when restored to his senses. For a warning to others? If unhappily the same circumstances should recur, other men placed in such a predicament, and driven to madness, if not deterred by the instinctive loathing of civilised man for the flesh of his fellows, would scarcely be influenced by Lord Coleridge's utterances and the final issue of the case.

On this view, that the Court was dealing with an act committed by madmen, all the authorities quoted and all the solemn comments made are flatly irrelevant. During the terrible Siege of Samaria, when women sacrificed their "weak and unoffending" children to prolong their own lives, the king rent his robes in horror; but he did not utter platitudes.

II. OBSERVATIONS ON FIBROUS PRODUCTS IN INDIA AND OTHER PARTS,

AND CONCERNING THEIR

ECONOMIC TREATMENT AND CULTIVATION.

By G. O'Brien.

THE natives of every country, from time immemorial, have been accustomed to utilise their fibrous plants; but want of roads, and the expense of transport from one country to another, restricted for the time their use to the respective localities where they grew: these hindrances no longer exist, and we are gradually becoming acquainted with their qualities and value, as also of the various methods employed in their preparation, and must acknowledge that the natives of Asia were the original discoverers of the inventions we still use, and with water as chief solvent. But each has much to learn from the other, and although the advance has been slow, inventors should be careful in putting forth their respective plans, and first ascertain whether they are original, as many of the latest methods patented have practically been in vogue for thousands of years in China and India, having only one fixed purpose—the cleansing of the fibre from resinous and calcareous matter.

I will therefore give the results of laboratory experiments, in order to analyse the subject in a practical manner, which exhibit that vegetable fibre is the most abundant and general ingredient of plants, existing in all their parts,—the root, leaves, stem, flowers, and fruit, amounting in compact wood to 98 per cent. It is obtained in a pure state by treating sawdust successively with hot alcohol, water, dilute muriatic acid, and weak potash lye, which dissolve first the resinous substances that bind the fibres together; secondly, the extractive and saline matters; thirdly, the carbonate and phosphate of lime; and lastly, any residuary matter.

In Europe our most familiar fibre is flax, and attempts at various periods have been made to supersede the ancient methods of steeping, and retting, using weak acids, solutions of caustic potash, and of soda, soap lye, and lime; but all have been found objectionable, as without excess of water

the fibres become discoloured or loaded with impurities, and chemical additions are expensive. The most important impulse given to the flax industry in Ireland was by the unfortunate Earl of Strafford, temp. Charles I., who procured from Holland workmen and seeds, and is remembered in Ireland as a benefactor and chief promoter of the industry. The finest cambrics are prepared by the ancient system of soaking for lengthened periods, and the same method still prevails in most parts of Europe, using a cage 12 feet long by 8 feet wide and 3 feet deep, filled with flax-stalk weighted with stones, and anchored mid-stream from the month of May until September. Therefore, from following in detail these experiences, we must infer that pure water is the best and cheapest solvent, as it gradually, but perfectly, cleanses the fibre from the resinous substances which bind it together, and in the most economical manner, leaving only the phosphatic and earthy residuum to be disposed of, by using afterwards alkaline lye or caustic soda, and which are required to bleach it for certain uses.

The decay of plantations in many parts of India, and the fall in value of various productions, has drawn the attention of cultivators to fibre plants, which are too numerous to attempt to mention; but an imported one, producing China grass, from its value in commerce has merited attention. It is obtained from the stalk of the *Bœhmeria* (*Urtica*) *nivea*, a plant belonging to the Urticaceæ or nettle order. And in sequence various patents have been obtained, professing effectual and economical treatment; but all of them must be received with caution when we consider our own experiences, and that India and China are much older nations than ourselves, and that we have not yet been able to supersede the very methods inherited from them. Thus, for example of an impossible one, in the year 1849 Messrs. Wright and Co. obtained a patent for the preparation of this fibre; their process consisting essentially in boiling the stems in an alkaline solution after they had been previously steeped for twenty-four hours in cold water, and also for twenty-four hours in water at 90° F.; the fibre is then washed thoroughly with pure water, and finally subjected to the action of high-pressure steam. Another German patent has made a new and useful departure, using bisulphide of lime under pressure of steam on pine fibre (shavings or sawdust), procuring wood-wool for surgical purposes, as also for clothing, but for which it cannot be considered as a competitor to like substances, animal or vegetable. All Orientals are acquainted with several species of the Sapan tree, which

produces pods serving as a substitute for soap, but not in sufficient quantities for manufacturing uses, and in efficacy could not compete with caustic soda, which can be imported into India from Europe at £8 per ton, and is the most likely substance to be useful after the resinous substances have been disposed of. And trials could be made, using for the purpose a wooden boiler, say 6 feet long and 14 inches wide by 14 inches deep, and bolted together by ½-inch screw-bolts inside the box, which should rest on walls of mud 3 feet high, with that clear space for a wood fire beneath; the sides of the boiler to be built in by a mud wall about 8 inches thick, to conserve the heat to boiling-point if required; and a small chimney is necessary to carry off the smoke and conduct the flame along the bottom of the boiler, which would last a long time if kept with water and clear from cemented sediment; and I have used such primitive boilers for other purposes, from knowing that they were used in our first steam-boilers in consequence of the urgent necessities of inventors, and only by such trials on the spot can advances really be obtained, following out in the main Chinese methods, which do not injure the fibre.

Dr. John Forbes Royle says of the *Bœhmeria nivea*, or Rhea fibre-plant, that it is likely to prove one of the most valuable products of India, for in strength it exceeds the best hemp, and in fineness it rivals the superior kinds of flax. Its culture is well known to the natives of Assam, and it has also succeeded in Tenasserim, and it is grown in Siam and other eastern countries and islands, and can now be produced, and sold with profit, at as cheap a rate as Russian hemp; and if any machine could be employed for facilitating the separation of the fibre from the outer bark and the woody parts of the stalk, it would speedily undersell all other fibres, as from four to five crops per year can be obtained from the same plants; it is identical with the Rhea grown in China, but of coarser quality. In its cultivation manure is required, and moisture essential to quick growth, as well as shade, and some protection from storms. It is grown from separate roots, and may be cut down several times in the year, and the aggregate produce of an acre is about 12 maunds.

"The different crops vary in quality, the earlier being the strongest and finest, and the veritable China grass sells in this country at from £60 to £80 per ton. Very serious faults have been committed in the process of cleansing Indian fibres, which have tended in a great measure to deprive them of their value for manufacturing purposes. In

order to save labour the usual practice has been to steep the plants till the sap and vegetable juices are thoroughly decomposed, as the fibre can then in most instances be easily beaten or washed out; but this method, though applicable to a certain extent in cold climates, where decomposition takes place slowly, is always found to be injurious to the fibre, and to be almost inapplicable in warm climates, where fermentation passes into putrefaction in a few days, and the decomposed fibre acquires acidulated and other properties, which not only deprives the fibres of their strength, but discolours them in such a manner as to render them unfit for manufacturing purposes. Most vegetable substances contain, besides the fibrous tissue, sap, cellular tissue, and a little colouring-matter. The sap consists of water, gum, fecula, and alkali, with sometimes tannin."

In the above explanation running water is not prescribed, which is necessary with high-priced fibres for cambrics, &c., in Europe, as well as in India.

From the "Cyclopædia of India," by Edward Balfour, I copied the following for those who have not read it:—

"The leaves, stalks, or barks of plants should be cut when in full vigour and of bright green colour, as when old or dry they yield coarse, stiff fibre, and no more plants should be cut than can be cleaned in two days, and the cut plants should not be left long exposed to the sun, as the sap dries up, and the process of cleansing them becomes more difficult. The sooner the sap, pulp, and impurities can be removed from the fibre the cleaner and stronger it will be. Beating, crushing, and scraping fibres improve their quality instead of injuring them, as was at one time supposed, provided it be not cut across or rendered short. If a plant be well crushed or beaten soon after it is cut it may be immersed for a night. Each district in India has its own particular fibres, all largely utilised by the people; thus it will be superfluous to detail them, but the beautiful fabric China grass cloth is made in Canton province, and the plant supposed to produce it is the *Urtica nivea*, and can be spun into thread for sewing purposes, and the cultivated variety has larger leaves than the wild plant, which grows plentifully on sloping banks, but is not prized by the natives, who say that its fibre is coarse and broken, and confined in its structure."

And Dr. Roxburgh describes it as the *Urtica tenacissima*, or China grass, and states that this nettle grows in all the moist countries, from Bengal, through Rungpore, Assam, and China, and adds:—

"*To Cut the Rhea.*—It is fit for cutting when the stems become brown for about 6 inches from the root, holding the top stalk in the left hand, and with the right hand strip off the leaves, by passing it quickly down to the roots, and cut off with a sharp knife, taking care not to injure the hairy work of the roots, as these should be covered up quickly to ensure rapid growth. Then lop off the tender stalks, and make up into bundles of 200 to 250.

"*To Strip off the Bark and Fibre.*—The operator holds the stalk in both hands nearly in the middle, and pressing the forefinger and thumb of both hands firmly, gives it a peculiar twist, by which the inner pith is broken through, and then, passing the fingers of the right and left hand alternately towards each end, the bark and fibre are completely separated in strands.

"*Making up of the Bundles.*—The strands of bark are now made up into bundles of convenient size, tied at the smaller end with a shred of fibre, and put into clean water for a few hours, which he thinks deprives the plant of its tannin or colouring-matter, the water becoming quite red in a short time.

"*Cleansing Process.*—The bundles are put on a hook fastened in a post by means of the tie at the smaller end, at a convenient height for the operator, who takes each strand separately of the larger end in the left hand, passes the thumb of his right hand quickly along the inner side, by which operation the outer bark is completely separated from the fibre, and the riband of the fibre is then thoroughly cleansed by two or three scrapings of the knife.

"This completes the operation with a loss of about one-fifth [should be about 95 per cent]. It is then dried, and is fit for exportation, but the appearance of the fibre is improved by a night's dew or a shower of rain."

The requisition to cut open and strip as much as possible China grass, in order to expose it to the action of water for the purpose of dissolving the gummy compounds which bind the fibres together, and this before they have become dried by sun and air, is absolutely necessary, otherwise—if these and also colouring-matters are not completely removed before drying—the fibrous parts become stiff, coloured, entangled, and useless. But when properly prepared the most beautiful fabrics can be manufactured with its fibre, and it is much coveted by our cloth manufacturers to strengthen the framework of the finest cloths as well as coarsest "shoddy," but the price demanded by the Chinese does not permit its general use. And it is noticeable that in limited quantities it

realises £80 per ton in England, but when the price lowers to £35 per ton then the Chinese entirely cease to export it; but for cloth we cannot afford to pay more than £25 per ton, and thus this beautiful fibre is prohibited to us from its price. The Government of India has offered a high reward for the best machine to prepare it, but inventors have misdirected their powers by using in the first instance chemical substances, or on machinery to be used after it is prepared, whereas the whole secret lies in treating the plant while still green and within six hours after it has been cut, and whilst adhesive compounds remain soluble; and it is clear that excessive handling must be avoided, as Chinese labour is the cheapest in the world combined with intelligence. And thus, as the substances to be got rid of are merely gum and tannin matter, and both as they exist in China grass are soluble in water, I find that by soaking the grass, when freshly cut, for eight hours in pure water (running stream is preferable), by placing the "grass" in a wooden box or crate with bars or spokes on all sides, and with a movable lid or cover made to rise and fall by means of a lever or lift, and thus wash out by pressure and motion the soluble substances, giving equal effect and pressure on all the plants whilst in the water; and the bottom of the crate can be made to rise and fall also, modifying it in shape and action to procure the effect needed. This method does not hurt the fibre in general if the bars be so adjusted as not to press on each other, and would effect the object desired at lowest possible cost, and I have sufficiently tested the plan myself to ascertain its effects. When the whole of the gum is got rid of, then the rest of the operation is easy, by drying the treated plant at once in the sun, and then separating by scutching machinery, producing in fibre only about 5 per cent of its original weight, the shortest fibre being serviceable for rough cloths, and the longer for superior requirements.

The above ideas are applicable to most fibre plants, and exhibit the necessity of treating them as fresh and green as possible.

130, Fenchurch Streeet, London, E.C.,
December 16, 1884.

III. IS DEATH UNIVERSAL?

A COUPLE of years ago we pointed out ("Journal of Science," 1882, p. 401) the curious fact that—as established by the researches of Bütschli, Weismann, and Goette—the monocellular Protozoa are not, like all higher animals, subject to death. From this fact we drew certain conclusions. The subject has since been further examined by Dr. K. Möbius ("Biolog. Central-Blatt, vol. iv., p. 389). The conclusions of this eminent *savant* may serve at first sight to differ from the views which we put forward; but on closer examination it will, we submit, appear that the difference is more verbal than real. Admitting the same facts, we apply to them merely somewhat different names.

In monocellular animals which propagate by division the entire bodily substance of the older individuals—as Bütschli and Weismann have proved—continues to live in the young individuals into which the former have resolved themselves by the act of fission. In the polycellular animals—the Metazoa—a part of the body, after passing through the various stages of its development, loses the power of carrying on vital processes, and dies. Hence Weismann ascribes to the Protozoa immortality. He argues that, as they are resolved by fission into a number of individuals of which no one is older and no one younger, we have an endless series of individuals, each of which is as old as the species itself, and each of which has the faculty of living on indefinitely by constantly renewed fissions. The higher organisms, on the other hand (the Metazoa), have lost this faculty of endless life. In them the immortality of the monocellular organisms is restricted to the reproduction-cells alone.

The reply of Möbius is substantially that, according to the definition hitherto generally accepted, we understand by the "immortality" of an individual living being the innate attribute, not destructible by external causes, of continuing for ever as an individual.

We must here convict Dr. Möbius of an inaccuracy of some importance. Weismann nowhere—as in common with ourselves—asserts the immunity of the Protozoa from outward causes of death. We said expressly that with the Protozoa death, "though common enough, is merely casual,

the result of some accident. Hence immortality is ascribed to them in a sense which is not dependent on the ordinary definition of the term."

Möbius now asks—Is this idea of immortality applicable to the Protozoa which propagate by fission? Do they persist as individuals until their life is destroyed by some outward agency?

He replies that adult Protozoa, in their fissiparous generation, leave no part of their body behind which can die. But they cannot on that account be regarded as immortal, for, on fission, their individual existence is gradually extinguished, and comes to an end in the moment when the daughter-offsets separate from each other. With the conclusion of the process of fission the mother-individual ceases to live, but the substance of its body carries on the same specific functions in the effects, and indeed with a rejuvenated susceptibility to external impression, which in the aged individuals had been gradually fainter and fainter, and had finally ceased altogether.

To this it may be replied that there are only two alternatives—death or deathlessness. If death occurs let the dead body—the mass of organised matter which has ceased to perform any vital function—be produced. Failing this evidence we must recognise deathlessness. When a monocellular Protozoan is killed by heat or poison, we have this dead body to produce. Consequently where it is not producible we fail to recognise true death.

Dr. Möbius continues—Whilst the bodily substance reacts more faintly to outward impressions, there appear in its interior striking movements which precede the fission of the maternal body, and evidently subserve the rejuvenescence of such substance for its progeny.

The retraction of the cilia, the disappearance of the flagella, the rounding off of the body, and its incapsulation before fission must enfeeble the irritability of the older individuals. The young offshoots begin their individual life with great susceptibility to external impressions, because their bodily substance consists of freshly-located molecules, and because the surface of their body is greater in proporto its mass than the superficies of the mother shortly before fission.

When an Infusorium completely uses up its entire body in the production of two, four, or eight young ones, every part of such body remains alive,—*i.e.*, the atomic groups, of which every offshoot consists, continue their life-work according to the same morphological, physiological, and

psychological laws as the mother, although each for its own individuality. The young individuals ingest nutriment, and transform it into their own bodily substance. Thereby they not merely replace the losses indispensable to vital work, but they accumulate also an excess of bodily substance in virtue of which they grow. When they have become as large as their mother, and are resolved into two offshoots, each of these inherits at most one-fourth of the vital mass of its grandmother. In the third fission each offshoot receives at most one-eighth, in the fourth one-sixteenth, and in the tenth at most 1-1024th of the ancestral body with which we started. We have here not taken into account the losses from decomposition which the ancestral substance must have undergone in all generations, since in the Protozoa one and the same bodily mass which is concerned in reproductions fulfils all other bodily functions. The Protozoa, consisting of one plastide only, possess no working plastides along with the reproductive plastides of the Metazoa. Subsequent generations of Protozoa consist, therefore, more and more of bodily substance which they have individually elaborated, and less and less of ancestral constituents.

The individualisation of the daughter offshoots begins with the first stages of fission in the mother. These stages are the unfelt and unconscious state of the separation and transformation or re-formation of organs before these are capable of receiving and utilising external impressions. This unconscious state gradually passes into the condition of sensibility and consciousness as soon as external impressions are received by special organs. Special sensations must be induced, even in the Protozoa, by contact with foreign bodies, by changes of temperature, by the ingestion of food, by changes of the form and the locality of the body, by the recognition of fellow-individuals, &c.

The Protozoa are, like the Metazoa, to be regarded as psychically centralised individuals. In the severed psychic centres of the offshoots the former psychic centre of the mother cannot persist, because her individual bodily and spiritual life is extinguished in fission. The Protozoa can therefore, from a psychological point of view, not be regarded as immortal.

It may here be contended that the author is assuming too much. There is every reason to suppose that the offshoots must inherit impressions made upon the mother, since each of them must inherit a part of her psychic centre.

In the stalked Protozoa, also, such as *Zoothamnium*,

Epistylis, *Codoriga*, the individual soul-life of the mother does not persist in her united descendants, since these, in addition to their common functions and feelings, receive individual stimuli and perform separate individual functions. The offshoots receive from their mother, on fission, merely the foundation for their individual bodily and psychic life. This simple basis of the new individual life is formed in the Metazoa by gemmules, or by germ-cells and spermatozoa.

The reproductive cells of the polycellular animals, or heteroplastides (Goette), transfer their vitality, like the bodies of the monoplastides, from individual to individual without an intermediate stage of lifelessness and death. They form, however, voluminous masses of other plastides for more powerful and varied life-work than can be executed by the tiny bodies of the monoplastides. These developed working plastides, incapable of reproduction, can, for the most part, still continue to work in their manner when the reproductive plastides have been separated from the body of the polycellular animal. Most heteroplastidic animals survive, therefore, their act of reproduction, whilst the individual existence of the monoplastides must come to an end with the act of propagation, since in them the working and the reproductive substance are identical.

Morphologically considered the body of the monoplastides corresponds to the reproductive cells of the heteroplastides. The life of both, however, is very different. Whilst the reproductive cells of the polycellular animals live on in a state of inaction till they are liberated, transmigrate, and develope themselves, the monocular animals enter into relations with the external world, even with the bodily mass concerned in reproduction, and may evolve for this purpose especial organs. The reproductive plastides contain groups of atoms for the formation of all the organs of the body of their species. The plastides of individual organs which have merely certain limited functions contain such atomic groups only which are suitable for the formation of young plastides having the same especial properties (protective, motive, nutritive, and sentient plastides).

The reproductive plastides of the Metazoa receive no direct stimuli from without, so long as they have not become liberated. Hence they are not worn out. They do not age by work like the working-cells; but as soon as certain external stimuli act upon them after liberation and fecundation, they act in accordance with their inherent properties with fresh and full energy. When the reproductive plastides of the Metazoa do not in a certain time become free

individuals, whose capacity for development is called into activity by certain external stimuli, they die off just as do the working plastides.

Upon all the latter external stimuli react more feebly when often repeated. They become weary, and their weariness terminates finally in non-irritability and in death.

The psychic centre or soul exerts a conservative action upon the body, which becomes fainter as the individual ages, because stimuli evoke feebler and feebler feelings of satisfaction, and elicit therefore fainter reactions.

It will be seen that, whilst Dr. Möbius has in many respects enriched our knowledge of the subject, he has not succeeded in showing in the Protozoa any phenomenon fairly comparable with death in the Metazoa.

IV. DEATH AND INDIVIDUALITY.

By C. S. Minot.

[We insert the subjoined memoir, taken from our American contemporary "Science," as throwing new light on a subject previously raised in our pages.]

THE current conceptions of death as a biological phenomenon are very confused and unscientific. In this essay I shall endeavour to analyse the problem, and, by placing the factors concerned in a clearer light, to diminish the obscurity in which the subject is still involved. This appears to me the more desirable because the recent publications of Weismann and Goette upon this general topic have increased rather than lessened the existing confusion. In fact these authors fail to make the necessary distinctions between the different kinds of death, the different orders of individuality, and the different forms of reproduction. This assertion is, I believe, justified by the following paragraphs:—

First, as regards individuality. Individuality, as it is generally understood (*i.e.*, as something always equivalent

to itself), does not exist in Nature, except subjectively as a rather fantastic notion of the human mind. The term "individual" is applied to things utterly incommensurate with one another. An individual protozoon, an individual polyp, and an individual insect, are not homologous and comparable bodies. It is mere slavery to a false form of speech to imagine that their "individuality" is a common quality; for, on the contrary, the same word indicates here three distinct phases. I know not how to account for the immense significance attributed to the mystical idea of individuality, which in reality corresponds only to a physiological capacity for a separate existence, but in usage is tacitly assumed to be the name of some vague fundamental property of life, which, however, the mind cannot apprehend. Now, we have renounced considering a wing in a bee, a bird, or a bat as identical or homologous with every wing, either on account of its name or its function. But, although the different kinds of individuals of animals and plants are much more unlike one another than are the manifold types of wings, yet individuality is generally taken to mean a uniformly identical something; and that is untrue. Of course the matter is really very simple, and indeed self-evident, as to its true nature; and the singular obscurity prevailing is probably due only to the problem not having been clearly thought over. At present the condition of opinion upon the subject reminds one of the ancient notions of beauty, according to which beauty was an inherent quality of objects, not an impression of the mind, a psychological state. Despite custom, it is plain that "individual" has many meanings; yet it is usual to compare "individuals" with one another throughout the animal kingdom. This error has been repeated by Weismann and Goette, because they both assume that the death of a single protozoon is equivalent to the death of one of the higher animals. Goette, however, has partially emancipated himself from this idea, which I believe to be errroneous. The death of a unicellular is entirely different from the death of a multicellular individual.

To Huxley we owe the first scientific determination of individuality. His essay on the subject ought to be thoroughly studied by every biologist. Life occurs in cycles of cells; *each cycle comprises all the cells springing from a single impregnated ovum;* the whole of every cycle is homologous with every other whole cycle, no matter whether every cell is a so-called individual, or whether they constitute several individuals (*e.g.*, polyps) or a single one (vertebrates). *All*

cells are homologous, all cycles are homologous; but individuals are not always homologous, since an individual may be either the whole or any fractional part of a cycle. This question I have discussed a little more fully in my article on "Growth as a Function of Cells" ("Proc. Boston. Soc. Nat. Hist.," xx., 190—201). Manifestly the death of the single cell is not necessarily identical with the termination of a cycle. Now, when a man, he being a cycle of cells, has lost the ability to continue the cycle, he (or it) dies. Further, it is inherent in his constitution to lose that ability gradually; hence, when it is completely lost from internal causes, he dies, as we say, from old age. It is to this ending-off of the cycle, from causes resident in itself, I wish to restrict the term "natural death."

We have now two questions to pose: 1. Do all organisms belong to cell-cycles? 2. If so, are all cycles self-limited? In common language the second question would be, Is death always the natural and inevitable accompaniment of life?—an inquiry which may appear singular, but is none the less perfectly sensible and legitimate. Weismann has answered it with a negative.

1. I maintain the hypothesis that all organisms do develope in cycles, and only in cycles; which involves the assumption that all living species begin their life-history with an impregnated ovum or its equivalent. We come, therefore, at once to the question of how far sexual reproduction extends downward in the scale of life. I deem it very probable that it extends to the lowest animated being, even though it be quite differently manifested in the lower forms from what we observe in ordinary bi-sexual reproduction. This view is opposed to the opinions generally held; for botanists trace the evolution of sex within the vegetable kingdom, and zoologists trace it, though less definitely, within the animal kingdom. We are thus forced to assume that sex, one of the most fundamental and characteristic phenomena of life, has arisen twice. This is to the last degree improbable. Such a coincidence would be the most extraordinary result of chance within human experience. It is more reasonable to suppose that, though we do not yet recognise it, the sexual function exists in the protobionts, which are neither animal nor vegetable, and that they also produce a body homologous with an impregnated ovum; and to suppose, further, that out of this common commencement both animal and vegetable sex have been evolved. The essential property of the sexually produced ovum is its power of repeated division, producing a succession of cell-generations, which, together with the original body (*ovum*), con-

stitute the cycle. There is much evidence of a positive character to confirm the belief of the cyclical course of life, even among the Protozoa and Protophytes, in which there occurs what is known as rejuvenation (*verjüngung*).

2. I maintain that it is probable that all cycles of cells are self-limited. Let us first ascertain the nature of the limitation. Our knowledge of the manner in which the cycles are limited (*i.e.*, of the causes of natural death) is very restricted, and derived solely from the higher animals. My own special investigations have been in this field, and have led me to the opinions and problems we are discussing.

My experiments demonstrate that, when properly analysed, the growth of at least the higher animals gradually diminishes from birth onwards, almost without interruption. This is an irrefutable mathematical verification of the views which I advanced in my article on "Growth as a Function of Cells," published in 1879, the essence of which, as far as we are now concerned, is that the cells of a cycle continuously lose their power of division, so that the interval between two successive divisions gradually increases. This involves the ultimate termination of the cycle, because the losses go on, not until the cells can no longer divide, but until they exhaust themselves. This whole series of changes is properly *senescence*, or growing old. Senescence is a continuous process, covering the whole period of a cycle of cells; and we must assume it is the positive loss of power in the single cells, such that the last-produced cells cannot continue, and *natural death* ensues. Of course, in the cases of a multicellular animal, death of the whole follows secondarily upon exhaustion of any essential part,—as in the case of insects, which die upon laying their eggs. In the higher animals, the cycle is limited by senescence, and senescence is a decay which probably begins when the cycle begins. The next point to decide is, whether the same phenomenon occurs with the unicellular organisms. If it is found that the divisions of a Paramecium, for instance, after a conjugation, are at first rapid, and then follow at increasing intervals, it would prove (provided always the external conditions remained constant) that we here had true senescence, with its sequel, natural death, or the end of the cycle. Until this point is settled we cannot know whether there is, among unicellular animals, a form of death homologous with the natural death from senescence in the higher animals and plants.

It is to be regretted that both Weismann and Goette appear not to know the article to which reference has just been made; otherwise they would have recognised that the

problem of death is, *first*, whether growing old (*veraltung*, *involution*) is a universal phenomenon of life. Weismann's first article was an address delivered before the German Naturforscher versammlung, September, 1881, and subsequently republished at Jena. He advanced then the view that for unicellular organisms there is no death except through accident; that the propagation being by simple division, we must assume that the process of division may go on for ever. He does not even consider whether the cells form cycles, and whether these cycles need to be renewed; so that he misses the real problem. On the contrary, he is enchained a prisoner to the mystical idea of individuality, and reasons as if individuality rendered direct comparisons legitimate between things essentially different. All his reasoning is based upon the idea that an individual protozoon is comparable to an individual dog, and so on. The argument just made against him was to show that the basis of his whole fabric is illusory. Bütschli, in his short article, called forth by Weismann's, partially liberates himself from the confusion as to individuality, and propounds the hypothesis of a *lebensferment*, which he supposes to be continually resumed in Protozoa, which he thus assumes to be potentially immortal. He also fails to recognise that the true question is, not whether single Protozoa die, but whether they form senescent cycles. In this error he is followed by Cholodowsky, who also admits that natural death is restricted to the multicellular animals, but overlooks what would be its only possible homologue among Protozoa.

Goette seems to me to have made a distinct advance beyond his predecessors, for he has attempted to show that there is a death common to all organisms. Especially is his conclusion that death and reproduction are intimately connected to be noted as important; but his thought appears to me often vague and obscure, and to many of his views I can by no means assent. I have just asserted that death and reproduction are intimately connected. Now, if r theory is correct, it is evident that each cycle, before i ost completely exhausted, must produce the initials of It cycles: hence the connection in time between maturity, t the approach of death, and sexual reproduction. By speculation upon the few available facts I have reached th following hypothesis:—Originally each cell of a cycle was a distinct individual; the exhaustion of the last cells of the cycle *caused* them to become sexual bodies and to conjugate; conjugation renews the power of division in the conjugated individuals, and therewith a new cycle is begun. Subsequently multicellular animals were evolved, and in these the

same phenomena recur; but some of the cells have become specially organised, and thereby incapable of assuming the sexual state: hence, when the end of the cycle approaches only a few cells become sexual, and the animal (or plant) is mature. The higher organisms become sexually active only after having grown for a considerable period, because they still preserve the primitive relation. Senility is the *auslösende reiz* of sexual reproduction. I hope to discuss the matter fully in a memoir which I am now preparing for the press.

It is evident that, according to this hypothesis, sexual reproduction depends on the exhaustion of the cells. There are many facts known to confirm this view. Thus among men the reproductive period begins sooner when they are ill fed. Among many of the lower plants reproduction is induced by defective nutrition. I believe that nutrition and reproduction are indeed opposed to one another, but by no means in the sense taken by Carpenter and Spencer. While I consider that the impaired nutrition causes the effort to reproduce, they believe that reproduction is opposed to nutrition, constituting a tax which withdraws just so much from the parent. Undoubtedly in those cases where the parent, in consequence of a secondary addition to the office of genesis, has to supply food to its young, reproduction may detract from growth, but, even in such cases, only sometimes. Carpenter and Spencer's whole argument rests upon the assumption that the power of assimilation is only just equal, or about equal, to the demands of the parent. It is, however, perfectly well known that the reverse is true, and that there is in most organisms a large surplus of assimilation possible, which is used whenever the functions demand it; hence in most cases the secondary taxes of reproduction can be wholly or mainly paid without calling on the growth capital of the parent. Spencer's *à priori* argumentation I consider superficial: it has led him to an exaggerated idea of an opposition which exists in Nature, but is not general. Moreover, Spencer has mistaken the cart for the horse: animals do not stop growing because they begin to reproduce, but they begin to reproduce because they stop growing; or, more strictly speaking, both events are due to one cause,—senescence.

It will be seen, upon reviewing the preceding paragraphs, that the views I advocate are opposed to all the other opinions upon the nature of death which have been noticed above. In a memoir I am now at work upon I hope to array a large number of observations to defend the theory outlined in this essay.

V. SPACE AND ITS DIMENSIONS.*

HAD either of the two works before us made its appearance half a century ago the author, if not straightway consigned to a lunatic asylum, would have been overwhelmed with derision. Little better would have been the lot of an unfortunate reviewer who should have ventured seriously to discuss such an audacious and unheard-of supposition. Times are, however, changed,—in this respect fortunately so—and we may at least take the possibility of *n*-dimensional space into quiet consideration.

One misunderstanding must be brushed aside at the outset: We hear it sometimes asserted that the conception of four-dimensional space, as at least possible, is, in some way or other, an outcome of Spiritualism. This is quite erroneous. The late Professor Zöllner did certainly maintain that some of the most perplexing phenomena manifested at spiritual séances could be explained by the hypothesis of space of four dimensions. But between the two there is no necessary connection. A believer in the genuine character of the so-called spiritual manifestations may reject and scoff at the poly-dimensional hypothesis. On the other hand, a person who accepts "poly-dimensionalism" may regard Spiritualism as fraud and delusion. For the rise and progress of this strange hypothesis the mathematicians are alone responsible. Strange, indeed, and suggestive that the most sober, rigid, and exact of the sciences should thus point the way to what the men of practical common sense will deem foolishness!

It will at once be granted that our senses and our ordinary experience tell us of three-dimensional space and nothing further. We take up any solid body whatever, and we find it has always, to our touch and sight, length, breadth, and thickness, the latter being often called depth or height. We stand in the open air and we recognise the same three dimensions—one, from east to west, another from north to south, and a third, from the ground on which we stand, upwards. We may, in thought, prolong any one of these lines indefinitely, or, on the other hand, suppose them reduced to microscopical magnitude we have still merely length, breadth, and

* Scientific Romances: No. 1. "What is the Fourth Dimension?" By C. H. HINTON, B.A. London: W. Swan Sonnenschein and Co.

Flatland: A Romance of Many Dimensions. By A SQUARE. London: Seeley and Co.

depth. How then do we escape from an experience so universal that it affects even our powers of conception? How are we led even to raise the question, "Why should there be three and only three dimensions?"

Certain very elementary mathematical considerations fully warrant us in making this inquiry, and even in seeing that space does not necessarily involve three dimensions, and neither more nor less.

We take for instance a line 2 inches or 2 centimetres long. If we multiply 2 by itself we have 2^2, or, as it is expressed in words, two in the square. This number, thus obtained by multiplying 2 by itself, we can symbolise as a square, each of whose sides is 2 inches long. We then again multiply 2×2 by itself and get 2^3, called 2 in the cube, or the cube of two. This result we again symbolise by a cube, a solid figure 2 inches long, 2 broad, and 2 thick or deep. Here, then, we have passed from the finite right line 2, to the plane figure 2^2, and again to the solid cube 2^3. But what if we go on and raise our original 2 to the fourth power or biquadrate, $2 \times 2 \times 2 \times 2$ or 2^4? This we can no longer symbolise by any figure we can see or touch, or even definitely conceive. We know that a finite line is bounded by 2 points, a plane square figure by 2×2 right lines, and a cube by $2 \times 2 \times 2$ square planes. Therefore, passing on in the same serial order, a figure representing 2^4 must be bounded by $2 \times 2 \times 2 \times 2$ solids. Now, we cannot realise to ourselves such figure. It must not be merely a larger cube; it must differ from the cube just as essentially as the cube differs from the square, or as the square differs from the right line. We cannot obtain the cube by superimposing any number of plane squares upon each other, because the plane figure has merely two dimensions. If we wish to generate a square plane figure from a straight line we must suppose the line to be moved in a direction *not contained within itself*, since the only possibility of motion in a straight line is from one of its extremities towards the other. In like manner, if we wish to generate a cube from a plane square we must move the plane in a direction *not contained within itself*, that is not in length or breadth, from the left to the right, or the front to the back, but upwards or downwards. All this is perfectly clear and simple. But suppose we wish to generate the unknown biquadrate. We must then in like manner move the cube in some direction *not contained within itself*. And here lies the difficulty, for the direction wanted lies outside the pale of our experience. But does our inability to point out this direction inhere in the very nature of space, or is it merely due to the limitation of human faculties?

Here both our authors have recourse to a perfectly legitimate artifice. Both suppose a set of beings, who are merely two-dimensional, having length and breadth, but not thickness, and to whom space—in fact the universe—appears two-dimensional also. To these hypothetical beings the third dimension, depth or thickness, appears as inconceivable and impossible as the fourth dimensional is apt to do to us. Mr. Hinton examines formally external phenomena as they must present themselves to such beings. The anonymous author of "Flatland" represents himself as a dweller in two-dimensional space. He describes to us his world with all its strange peculiarities, interweaving with his story much satire of perhaps questionable relevance. Especially is it to be noted that research in certain directions is in "Flatland" discountenanced, not merely by social penalties, but—as in modern Britain—by positive law. Researches into the origin of light are strictly forbidden, and the author himself is ultimately doomed to perpetual imprisonment for having indiscreetly expressed a belief in the possibility of three dimensions.

Whether to a polydimensional intelligence our beings and doings will appear as absurd as those of the Flatlanders,—here described—do to us, is, from the present human point of view, an unapproachable question.

Previous to the supposed author's conversion to a recognition of three dimensions he has a remarkable dream, after an evening spent in geometrical studies. He sees in imagination a one-dimensional world, Line-land. Its inmates are aware of only one dimension in space, and can no more conceive of two dimensions than the Flatlanders can of three, or than we worthy Spacelanders,—as the author calls us—can of 4, 5, or *n* dimensions. He has a long discussion with the king of Line-land, and vainly tries to convince him of the limits of his own existence and of the possibility and reality of two-dimensional space with its necessary results. To the king of Line-land a voice or any other manifestation coming from any point save exactly before or behind him seemed to originate in his own inside. This vision made our Flatlander thoughtful. There dawned on his mind a vague, dim presentiment that there might exist worlds or regions of being of more than two dimension,—as inexplicable to him as a fourth dimension is to us.

A further incident now occurred to disturb his traditional notions of the nature of space. He has been giving his little grandson, a boy of "unusual brilliancy and perfect angularity," a lesson in arithmetic as applied to geometry. He

is told that 3^2 represents the number of square inches in a square whose side is 3 inches long. The boy replies:—"You have been teaching me to raise numbers to the third power; I suppose 3^3 must mean something in geometry; what does it mean?" "Nothing at all, replied I, not at least in geometry, for geometry has only two dimensions." The author then proceeds to show his grandson how a point by moving through a length of three inches makes a line of three inches, which may be represented by 3; and how a line of three inches, moving parallel to itself through a length of three inches makes a square of three inches every way, which may be represented by 3^2. Thereupon the boy returned "Well, then, if a point by moving three inches makes a line of three inches represented by 3, and if a straight line of three inches moving parallel to itself makes a square of three inches every way, represented by 3^2, it must be that a square of three inches every way, moving somehow parallel to itself, must make a something else of three inches every way, and this must be represented by 3^3."

As a punishment for this heretical and paradoxical outbreak the boy is sent to bed. Shortly afterwards our hero becomes conscious of a presence in the room. Seeing, however, nothing, he soliloquises:—"The boy is a fool, I say; 3^3 can have no meaning in geometry." To his horror a voice replies:—"The boy is not a fool, and 3^3 has an obvious geometrical meaning."

Not to enter into details, our Flatlander finds that he has a visitor from the three-dimensional world, who endeavours, though vainly, to open his eyes to the comprehension of space and body as it appears to us. At last the stranger soars away with him into a new world where wonderful revelations await him. He is introduced to cubes, and he learns to distinguish between a circle and a sphere, a plane figure and a solid. But he now curiously turns the tables upon his guide. Having mastered the idea of three-dimensional existence he craves to go higher. He pleads:—"What, therefore, more easy than now to take thy servant into the blessed region of the fourth dimension, where I shall look down upon this land of three dimensions, and see the inside of every three-dimensioned house, the secrets of the solid earth, the treasures of the mines in Spaceland, and the intestines of every solid living creature, even of the living and adorable spheres." To his disappointment he is told "There is no such land; the very idea of it is utterly inconceivable."

But our Flatlander refuses to be so silenced. He quotes the words used by his guide when instructing him in the

nature of solids. He exclaims, after summarising the generation of a line from a point and of a square from a line:—"In three-dimensions did not a moving square produce that blessed being a cube, with eight terminal points? And in four dimensions shall not the motion of a divine cube result in a still more divine organisation with sixteen terminal points? Behold the infallible confirmation of the series, 2, 4, 8, 16: is not this a geometrical progression? Is not this, if I might quote my Lord's own words,—'strictly according to analogy?'

I ask is it not the fact that ere now your countrymen have witnessed the descent of beings of a higher order than their own, entering closed rooms, even as your Lordship entered mine without the opening of doors or windows, appearing and vanishing at will?"

As the reward of his pertinacity he is precipitated back into Flatland, where his after-fates need not concern us.

Now all this, it may be said, affords no demonstration of polydimensional space and of the existence of beings able to see and act in such space. But it supplies us at least with a chain of analogies which the great principle of continuity bids us at least to deal with respectfully. It further proves why and how we cannot directly picture to ourselves space of higher dimensions than our own.

The mere possibility of such space—of a fourth dimension—is a serious consideration. We shall find on reflection that much which on the hypothesis of three dimensions as the only conceivable seems absolutely impossible becomes easy, whilst the very foundations of the more exact sciences will be found to be simply subjective, having their bases merely in the limitations of the percipient Ego. In this direction, be it remembered, all science is slowly but surely tending.

It seems to us impossible that any being should enter into a closed room having no aperture in ceiling, walls, and roof; should see and describe the contents of a locked box or drawer without unlocking or breaking it open, and should take out certain articles and introduce others.

But the comparison with space of two dimensions will render such feats easy to a four-dimensional being. Let us suppose a Flatlander, a being with faculties something like our own, but possessing length and breadth only without thickness. We draw around him a continuous line in the form of square, triangle, circle, or other plane figure. It is obvious he cannot escape without rupturing the enclosure. Or, if we place him outside such a figure, he will be unable

to see or in any way interfere with articles within the figure. Having no depth, and being incapable of rising above or sinking below his plane, either of which actions would imply a third dimension, he cannot look down into the supposed figure. On the other hand, a three-dimensional being, or perhaps we might better say a being capable of acting in three-dimensional space, experiences no such difficulty. He looks over, or steps over the *boundary lines* without interfering with them, and acts at his pleasure in their interior.

Now, by analogy, if a four-dimensional being exists, he will be able to pass into closed rooms or to see and touch articles in closed boxes, &c., without in the least interfering with their *boundary planes*. Just as one of us can enter a closed square or circle from a direction which to the supposed Flatlander would be invisible, inconceivable, and, indeed, non-existent, so the four-dimensional being would enter our rooms, our prisons, our locked chests from a direction perfectly open to him, though to us as "invisible, inconceivable, and practically non-existent" as in the third dimension to a Flatlander.

Nor would it be at all necessary that such a being, four-dimensional or *n*-dimensional, should be of spiritual nature. It may quite as well be material. That is to say its material frame would not in the least interfere with its power of performing in the most natural manner actions which we should regard as supernatural or miraculous.

Mr. Hinton does not consider that there is anything in the world as we know it which would indicate the possibility of there being an existence in four dimensions. But the evidence has scarcely been sought for. It is submitted that if a fourth dimension exists there are two alternatives: either, whilst there are four dimensions, we have a three-dimensional existence only, or, that our existence is really four-dimensional, but we are not conscious of it. If the former alternative be correct—if we exist in three dimensions only, while there really exist four or more dimensions—we are then, with reference to beings which exist in four dimensions, what lines and planes are in relation to us,—that is, —mere abstractions!

VI. SANITARY VAGARIES: THE NEW RIVERS' POLLUTION BILL.

By "Argus."

WHEN the sudden approach of danger finds John Bull, as usual, unprepared, he passes at once from heedlessness to panic, and adopts measures which certainly do not bear the stamp of sober reason. This rule has been fully verified by occasion of the recent—and perhaps future—approach of the Asiatic cholera.

The Metropolitan Board of Works, obliged to take some steps to correct the nuisance due to the discharge of sewage at Crossness and Barking Creek, but unwilling to adopt any really efficient means, came upon the costly and absurd scheme of pouring first chloride of lime and then sodium permanganate into the river.

Then, as a slight concession to common sense, they added these same chemical agents to the sewage as discharged! It is not too much to say that had the late chemical adviser to the Board, Mr. Keats, still been alive this expensive farce would never have been heard of.

In the course of the season Sir J. B. Lawes delivered himself of the profound suggestion that we should not seek to apply the sewage of our cities to the land, but should cheerfully carry it to the sea,—of course at an enormous outlay—in the hope that it will thence come back to us in the form of fish! It is needless to enquire what proportion of the organic matter in the sewage would be directly or indirectly eaten by food fishes. But I think the public will agree with me when I say that until the so-called "Bummarees" are completely improved out of existence feeding fishes will prove from a national point of view a very poor investment.

But even this scheme is outdone by the proposal of Prof. Henry Robinson, brought forward at the Dublin meeting of the "Sanitary Institute," and reported in the *Sanitary Record* for October last. This gentleman—an engineer if I mistake not—wishes to adapt clay lands for irrigation by digging it out to a depth of six feet, burning it into layers interspersed with an occasional layer of open alluvial soil. If such a plot is well drained it will, we are told, continuously clarify the sewage of 1500 to the acre. The cost of preparation, however, reaches, according to the proposer's

estimate, to the modest sum of from £750 to £1000 per acre. Every one knows that such estimates fall far short of the actual cost of engineering schemes when reduced to practice. But let us take a town with a population of 300,000 persons —say Leeds. At 1500 persons per acre, we require then 200 acres of land, to be prepared at a first cost of £200,000! Nor is this all: Professor Robinson is of opinion that the larger particles in the sewage should first be removed by a process of ascending filtration and dug into low-lying land. Thus even if we assume that the acres stated will go on for ever purifying an unlimited quantity of sewage we must see that a very considerable annual extent will be incurred. Nor must it be forgotten that the plots of land thus "prepared" will be thereby converted into deserts, which neither art nor nature will be able to reclaim.

But I must hasten on to my main subject—the New Rivers' Pollution Bill. It may doubtless seem strange that the Act of 1876 should be repealed before it has had a fair trial and a new measure introduced in its stead. The old Act has not been successful, because the authorities have been remiss in putting its provisions into execution. Is there any reason to suppose that the enactment of a fresh law even every year would render them more zealous?

The new Bill has for its godfathers or godmothers Earl Percy, Colonel Walrond, and Mr. Hastings. Who are its parents is, of course, a secret, if an open one. Perhaps its appearance furnishes the key to the mystery why Dr. P. Frankland, last April, had the hardihood to disinter the peculiar views of the late Royal Rivers' Pollution Commission. It may easily be guessed who, and who only, must have felt uneasy at the omission of a certain notorious set of "Recommendations" from the Act of 1876.

To tell the truth, however, that Act is characterised by two grave omissions. It did not at all attempt to codify the law on the pollution of rivers. It was what lawyers, I believe, style a "cumulative" measure, that is, a law which provides new penalties and new procedures for certain omissions and commissions, but leaves all old statutes, laws, or customs bearing upon the particular subject still valid. A riparian proprietor who knows or fancies that a manufacturer or a municipal authority is polluting a river has still a choice of procedures. He may take action under the statute of 1876, or he may, I suppose, apply to the Chancery Division of the High Court of Justice for an injunction.

Now this power of option may be very convenient to a litigious person; or it may suit the purposes of certain

lawyers. But it is, I submit, grossly unfair to manufacturers and to municipal authorities. Both are, surely, in common fairness, entitled to have open to them a clear, definite statement of what is legal and what is illegal as regards the pollution of rivers, so that they may know when they are obeying the law, and may feel that when so doing they are not open to any proceedings whatever.

Another defect in the Act of 1876, and in all existing law on the subject, has only been brought to light within a few months. The Law provides remedies in case of the pollution of any river, brook, lake, or other piece of water *open to the air and light*, but concerning underground waters it is silent. A brief explanation will here be necessary. A certain person, A. B., had within the limits of his property a well which supplied his household with potable water. On his neighbour's property there was also a well, disused as a water-supply. The said neighbour, however, took upon himself to turn the sewage of his house into the abandoned well. In due course of time the various kinds of polluting matter found their way through the intervening subsoil, and contaminated A. B.'s well. The latter took proceedings at law for the abatement of so serious a nuisance; but the judges, finding neither statute nor precedent bearing upon the question, were compelled to decide in favour of the defendant, as he had not broken the law.

Hence there are two open and palpable defects in the Act of 1876, and it might be naturally expected that in any attempt to amend, or rather to supersede, that measure, those deficiencies would not have been overlooked. Such expectations, however, if entertained, are delusive. On carefully examining the new Bill, as printed, I find assuredly no provision against the pollution of underground waters, and just as little any attempt at a codification of the law on river-pollution. On the contrary, it is distinctly laid down that—"The powers given by this Act shall not be deemed to prejudice or affect any other rights or powers now existing or vested in any person or persons by Act of Parliament, law, or custom; and such right or power may be exercised in the same manner as if the Act had not passed, and nothing in this Act shall legalise any act or default which would, but for the Act, be deemed to be a nuisance." Here, therefore, the notion of codification, as far as the language used is intelligible to other than lawyers, is distinctly repudiated.

I may be asked, What is the novelty of the new Bill, or on what can its claims to supersede the Act of 1876 be

possibly based? The chief novelty which I can perceive is that the "Recommendations" of the Rivers' Pollution Commission are here introduced and adopted as "standards of purity." Is it then to be understood that the proposed measure is intended not so much to promote public health as to soothe the wounded feelings of the ex-Commissioners?

During the discussion which took place upon the reading of Dr. P. Frankland's paper the sanitary world was entertained with an account of the tenacity of life displayed by septic and pathogenic microbia. Whether the experiments on which the lecturer's statement was founded were fairly performed, or were conclusive, is not now the question. But the tenacity of life of disease-germs is trifling compared with that of the "Recommendations." They have been weighed and found wanting. They have been exposed to currents of calm critical inquiry and fried, so to speak, in derision. Yet in official brains—nowhere else—they still survive. Surely they are the most singular disease-germs ever known!

I may be told, as I am fully aware, that these "Recommendations" were proposed by a chemist of undoubted eminence, after careful and prolonged inquiry. I admit, most cheerfully, the eminence of the chemist in question, but I deny his practical sense and his power of freeing himself from "dominant ideas." It is written that this same chemist once applied for and obtained a patent for using common crystalline alum as a commercial source for the salts of potash! Can the absence of practicality be much more plainly shown?

I have been told by an advocate of the "Recommendations" that they would admit such water as that of the Irwell below Manchester. If this is the case, what more is needed to justify their rejection?

The great fault of the new Bill is that it pays no regard to the river itself, but looks merely at the quality—not the quantity—of the waters poured into it from manufacturing establishments, the sewers of towns, &c. If each of these emits abundance of water slightly within the proposed standards, the river, especially if small, will be brought to the condition of the Aire, the Calder, or the Irwell.

As concerns dissolved mineral impurities the Bill revels in inconsistency. It fixes a very stringent limit for arsenic, and to the neutral salts of soda, lime, and magnesia it gives free admission in whatever proportion. For all other metals it assigns one common limit—2 parts by weight in 100,000. Now, as the "Chemical News" very justly argues,

some of these metals—such as chromium, lead, zinc, &c.—are formidable poisons, whilst others—such as aluminium and iron—are practically harmless in any proportion likely to find its way into a river. Surely then aluminium and chromium require each a different standard.

It is a mistake also to suppose that the unlimited introduction of the salts of sodium, calcium, and magnesium into water-courses is a matter of indifference to the health of man or beast. In my former article on the sewage question ("Journal of Science," 1884, p. 256) I remarked that it was not demonstrated that "the carbonates and sulphates of lime and magnesia are detrimental to health." But I was here speaking of the calcium and magnesium salts only when in such proportion as they are naturally found in rivers, lakes, &c. Even the so-called mineral springs, though beneficial in certain diseases, are hurtful to men in a normal condition, and cannot serve as a domestic supply. How much less, then, should it be permissible to turn unlimited quantities of these salts into a river?

The fact is that, both as regards mineral and organic impurities, the Rivers' Pollution Commissioners laid down arbitrary standards which they have never been able or willing to justify.

But there is little occasion to go into a criticism of details. The fundamental principle of fixing a standard for the quality of waters which may, or may not, be permitted to flow into a river is vicious. All laws adopting it actually court evasion. If it is desired to turn into a stream some water which the standards would prohibit, nothing can be easier than to pump up water from such stream so as to dilute it to the degree needed. What, then, will be gained by the standards? As the "Chemical News" remarks:—"We trust that even the inspirers of this Bill will not be able to shut their eyes to the fact that whether we pour into a river daily 100,000 gallons of water containing 2 parts of organic carbon or 200,000 gallons containing half that proportion the total quantity of pollution conveyed into the river remains the same."

There may, and probably will, be found cases where the river is worse than the sewage or waste water discharged into it. In view of such cases the Bill declares that:—"It shall be no defence to any offence against this Act to prove that after any offence against the Act has been committed, the water of the stream is less polluted than is defined by the standards of purity hereinafter mentioned." I may add that should this Bill unfortunately become the law of the land it may happen that a manufacturer shall incur heavy penalties

for turning into a stream water purer than the stream itself, if only such water in any one respect exceeds the standards.

Further still: If a stream is in any one point less pure than is required by the standards it will be an offence to take out a quantity of such water for any purpose and let it flow back again in its original condition.

It is not even certain that a manufacturer or a municipal body will be safe if they keep their waste waters within the standards. It is hard to say what snares may lie within the following provisions:—

"In proving any offence against this Act evidence may be given of repeated acts which taken together may cause such offence, although each act taken by itself may not be sufficient for that purpose." What may not, by the aid of able and unscrupulous counsel and unscrupulous experts, be construed into an infraction of the law!

It will be further evident from the very use of the terms "organic carbon" and "organic nitrogen," that any suspected water will be analysed by the processes employed in the laboratory of the late Rivers' Pollution Commission. The trustworthiness of this method may be judged by a reference to the specimens given in the "Journal of Science" (1884, p. 260). Who could feel easy knowing that in virtue of such analyses he may incur a penalty of £50 per day?

I further perceive that in Section C mention is made of "directing a person found guilty of an offence against this Act to use proper and sufficient modes and means, or *certain prescribed modes or means*, for the prevention of a pollution to any stream, &c." Does there lurk in these words an attempt to prohibit precipitation processes for the treatment of sewage and waste waters, and to force "broad irrigation" or "intermittent downwards filtration" upon the public?

Duly considering all these points I feel it my duty to warn all manufacturers and municipal authorities to oppose this Bill at every stage and by every means. Earl Percy, Colonel Walrond, and Mr. Hastings doubtless mean well, but they have fallen into the hands of untrustworthy advisers.

ANALYSES OF BOOKS.

A Treatise on the Principles of Chemistry. By M. M. Pattison Muir, M.A., F.R.S.E., Fellow and Prælector in Chemistry of Gonville and Caius College, Cambridge. Cambridge: The University Press.

For the first time since the formal installation of "the new chemistry" we have an attempt to supply the student with an English equivalent to Lothar Meyer's "Modernen Theorien der Chemie." The result of this praiseworthy and laborious undertaking is a philosophy of chemistry of signal value to the true student. The *true* student,—that is the man who seeks for something more than to store his memory with facts, more or less satisfactorily established.

Mr. Muir's fitness for his task will be at once admitted by such of our readers as have carefully perused his paper on "Recent Chemical Researches" ("Journal of Science," 1876, p. 30), and his memoir on "Scientific Method" (*Id.*, 1877, p. 476), whilst the spirit by which he is actuated may be judged from the motto which he selects for his title-page:—"In Nature everything is distinct, yet nothing defined into absolute independent singleness."

In proof of Mr. Muir's ability to distinguish true progress from mere change dictated by and ministering to a frivolous vanity, we may quote the following passages, which would have gladdened the heart of the late Hermann Kolbe. Speaking of the difficulty of expressing the "power of doing" of a compound in an intelligible formula, he writes:—"I call the student's attention to the kinetical aspects of the structural formulæ now used in chemistry, because I consider it of paramount importance that he should remember how little information these formulæ give in comparison with what we should desire to have; that he should not forget that the experimental methods by which these formulæ are obtained are for the most part kinetical methods, while the interpretation of the results is expressed in language which has grown out of almost purely statical considerations; and that while he recognises the vast importance of structural formulæ, he may still refuse to bow the knee to this chemical Baal which has been set up in these times, so aptly described by Remsen as the era of 'formula-worship.'"

Again he writes:—"I have tried always to exhibit the hypotheses of chemistry as at once arising from facts and serving as

a guide in quest of facts. It is especially necessary to do this, I think, in dealing with the questions concerning structural formulæ. If these formulæ are dissociated from the chemical facts which they symbolise, they become intellectual tyrants; if each formula is considered simply as a summary of facts regarding the compound formulated, they are to be classed with the other 'brute beasts of the intellectual domain,' and cease to have much interest for one who believes that chemistry is a branch of science."

These passages may suggest serious reflections not a few. At present we will merely hint that the modern love for structural formulæ may be due to the contemporary examination-mania. The power of remembering "spread-eagles," reproducing them on the black-board, and expounding their supposed meaning is easily tested by the examiner,—one great duty of the "coach" being to ascertain what particular breed of spread-eagles any given examiner recognises in the only legitimate and *heil-bringende*.

A prominent attribute of Mr. Muir, as it was of Kolbe, is his dislike of vagueness and looseness of thought and expression. Thus we find him writing:—"Much is to be expected from researches into the phenomena which occupy the border-land between chemistry and physics. If the knowledge chemists already have of the structure of molecules, meagre though that knowledge be, can be supplemented by definite dynamical conceptions, obtainable in part by the methods of thermal chemistry, then we may hope that chemistry will enter on a new stage of advance as a branch of the science of matter and motion. It seems to me that a most important step will be made if the bond-theory of valency is generally abandoned; with it will go all those quasi-dynamical expressions, the offspring of loose and slipshod ways of thinking, which have gathered round that strange anomaly a 'unit of affinity' employed as a variable standard for measuring nothing."

Further, in passing judgment upon Berthelot's thermo-chemical researches, our author says:—"Berthelot's work is saturated with the conceptions of the molecular; but by some fatal perverseness he refuses to apply this theory to chemical phenomena. While recognising the existence of molecules, and building his generalisation on a molecular foundation, he refuses to accept the conception of atom, or rather he hopelessly confuses it with that of equivalent. The molecule is for him a definite and definable portion of matter; the parts of the molecule are only numbers."

The periodic law is very fully and clearly discussed. It may, however, be doubted whether the merit of Mr. Newlands, in the initiation of this important generalisation, is brought into sufficient prominence. "Meyer's curve and its explanation are given. Carnelley's suggestion, that the fusibility of the elements varies periodically with their atomic weights, is discussed,

and it is pointed out in a note that—according to the recent determinations of Nilson and Petterson—the melting-point of beryllium chloride is from 100° to 150° C. lower than the temperature assigned by Carnelley. Further developments of the periodic law, due to the researches of Hartley and Laurie, are also mentioned. The former chemist shows that the ultra-violet spectra of elements of the same series exhibit fairly-marked analogies in their general character. Still the spectra hitherto obtained do not warrant either the assertion or the denial of numerical relations existing between the different groups of lines, sufficient to establish a definite periodic connection between the atomic weights of the elements and the wave-lengths of the lines in the elementary spectra.

Laurie shows that there exists a distinct periodic connection between the atomic weights and the combining heats of the elements with chlorine, bromine, and iodine.

The author closes this chapter with the remark that it is interesting to observe in the periodic law "the survival,—perhaps rather the resurrection,—in a modified and more precise form, of the old conception of the element as an essence or principle capable of impressing on all substances into which it entered properties sufficiently definite to mark off all these substances from all others which did not contain this principle."

The author observes, concerning the "nascent" state and "nascent" action, that this expression has been at once helpful and hurtful. "By classing under a common head many phenomena which might otherwise have been lost in the vast mass of facts with which the science has to deal it has done good service. On the other hand, on the principle that

> 'Wo Begriffe fehlen
> Da stellt zur rechten zeit ein Wort sich ein,'

its use has tended to prevent investigation."

In treating of chemical change and its conditions the author calls attention to the influence of mass. He insists, in passing, on "the importance of considering the relative masses of the reacting bodies in all processes of chemical change, and to remind the student that this factor is almost universally ignored in our ordinary chemical equations."

The questions of the origin of the elements, of their possible decomposition or their mutual transformation, are not taken into account. The author—not without grounds—doubtless holds that such speculations are metachemical rather than chemical, and that the time for their definite solution cannot be said to have arrived.

In examining Mr. Muir's work we have been insensibly led, instead of giving a connected analysis of its teachings, to call attention to his views on a number of the most important sub-

jects in the philosophy of the science. These considerations, though of necessity somewhat fragmentary, will, we hope, bring the merits of the book into a sufficiently clear light, and justify the reader in undertaking its connected study.

The Round Table Series. IV. *Walt Whitman, Poet and Democrat.* By JOHN ROBERTSON. Edinburgh: Wm. Brown.

NEVER did we take up a book with so much hesitation and diffidence as the one before us. To our best knowledge the author has not in any way come in contact with the interests which we represent. Unlike many poets and literary men of the present century—we need only mention, Campbell, Keats, Elliott, and Tennyson—he has not even sneered at Science. Of his writings we have encountered nothing beyond a few extracts and reviews, which have escaped our memory, and what is to be found in the present treatise.

The subject of Mr. Robertson's exposition is described on the title-page as "Poet and Democrat." Now we have little sympathy with democrats, or indeed with "crats" of any kind. We would not here be misunderstood. We do not necessarily avert our eyes from, and close our ears to, a man because he has decided political opinions, nor even because he seeks to enforce such opinions. But the man who is essentially a "crat"—who cannot be truthfully described if we leave his "crat"ism on one side—is as much outside our mental sphere as is Sulitelma, or the Table Mountain, at the present moment outside the range of our eyesight.

Mr. Robertson tells us that "his [Whitman's] is the naïf popular Theism of the day, which finds the universe made for man, and the land for the race." Is this creed, the unphilosophic version of the old aphorism "Man the measure of all things," in need of any new preachers and advocates? Should it not rather be zealously unpreached? We fear that one of the tendencies of the "fanaticism of democracy," to quote Mr. Robertson's expression, will be a return to the great Socratic apostasis, —that is, an attempt to turn away attention from external nature to man.

Against such a tendency we must earnestly protest, feeling that there is more salvation for our race in the labours of the student of physical and natural science (*e.g.*, eugenism) than in all the jugglery of franchise-mongers, and all the frothy talk of the moral societies.

We read—"But Whitman is in nothing more remarkable than

in the exaltation, the fervour with which he sings of love between comrades. . . . His faculty of brotherly love is one of his most potent inspirations." Brotherly love is a very questionable feeling. One of the most objectionable types of the drunkard is he who, as he reels home, insists on shaking hands with every-one, and who is ready to quarrel with all who decline to touch his beer- and tobacco-scented paw. The first French Revolution was intensely brotherly when it exclaimed "*La fraternité ou la mort.*"

Whitman is described as self-esteeming, vigorously egotistic, intolerant. Now it is noteworthy that at present there exist not a few minds of this stamp, who, whilst advocating the claims of the individual against the community, would proscribe every form of activity but their own. French democracy, when handing over Lavoisier to the headsman, declared that the Republic had no need of chemists; the Corn-Law rhymer, Ebenezer Elliot, is unmeasured in his contempt for the working-class naturalist; and modern English organs of popular opinion "were instant with loud voices" that no part of the surplus from the Fisheries' Exhibition should be applied to fitting up marine zoological stations. And these voices, whether or not backed by those of the chief priests, prevailed.

It is remarked by Mr. Robertson that Whitman "is never heartily humorous in his writings," and that he even "sees in the American habit of jesting on all things one of the unhealthy aspects of things democratic." We do not know whether this tendency is exclusively American or purely democratic. The kings and barons of the Middle Ages had their official "jokers of jokes." We in England generally contrive to have at least one circus-clown in our Parliament. But perhaps the democrat, as he is his own sovereign, thinks it necessary to be his own court-fool at the same time. Yet even if the tendency to perpetual joking is world-wide it needs a rebuke, and that such should come from America is all the better.

Of poetical merit we are certainly no fitting judge; but we may at least ask whether a contempt for rhyme, for rhythm, and for grammatical accuracy is of itself sufficient to constitute poetry, especially in the absence of great thoughts?

The following passage, due, as the reader might well suspect, not to Whitman, but to Mr. J. Robertson, deserves serious consideration:—"People profess to believe in Evolution, yet treat every new speculation as less an error than a crime." At least let Whitman, his morals and other respects being granted irreproachable, receive from cultured men the tolerance with which they view the domestic transactions of Socrates and the social doctrines of Plato.

But what of the following?—"The disciplined thinker who believes in democracy and progress would fain that the poet had arrived at a fuller system of thought,—that Whitman had been

Comte." Surely one Comte has been something more than sufficient.

Concerning the ability with which Mr. Robertson has handled his subject there can be no dispute; but we could have wished him a worthier task.

Journal of the Royal Microscopical Society. Containing its Transactions and Proceedings, and a Summary of Current Researches relating to Zoology and Botany (principally Invertebrata and Cryptogamia), Microscopy, &c. Edited by FRANK CRISP, LL.B., B.A., &c. Series 2, vol. 4, 1884, pp. 1008. Published for the Society. London and Edinburgh: Williams and Norgate.

THE present volume, as is the case with its predecessors, in the present series contrasts strongly with the two small books issued during the early years of the then Microscopical Society of London and containing a selection of papers read before it, few in number indeed, but by such eminent pioneers as Dr. Bowerbank, Dr. Carpenter, Professor Owen, Edwin and John Quekett, Cornelius Varley, Rev. J. B. Reade, and other well known names in the list of microscopists. As the Society increased, so its publications grew, and now, forty-four years after its foundation, form a goodly array, containing a perfect treasury of histological research.

The origin of this now influential society was small like the early volumes of its transactions. About the year 1828, the late Mr. J. S. Bowerbank became the possessor of one of the then famous microscopes constructed by the late W. Tulley, of Islington; although the objective of this instrument was only a triplet of about nine-tenths of an inch focus, and constructed somewhat after the manner of the object glass of a telescope, its performance was far superior to any microscope at that time procurable, and as not more than four or five were then in existence, many persons resorted to Mr. Bowerbank's house to confirm their observations by means of the new instrument. These visitors became so numerous that at last it was necessary to set apart one evening in the week, and Mr. Bowerbank's Monday evenings were for many years noted for their interesting character and the number of eminent men frequenting them. As to the difficulties observers met with in those days, it is hard to realise them now, when everything is so easily procurable; glass slips had to be cut by the observers themselves; thin glass covers were unknown for some time. The best of microscopes could probably be now surpassed by some costing about five pounds, and mounting in

balsam was a new invention. From these social gatherings the Microscopical Society of London originated; a meeting was held on the 3rd of September, 1839, and the society formed. More than forty years have elapsed, and not one of the seventeen founders are now living. Prof. Owen was elected the first president in 1840, and has been followed by a succession of eminent microscopists down to the present time. The Monday evenings continued for some years longer, and served admirably for the purpose of recruiting the new society. They were only discontinued when their amiable founder ceased to reside in London. The work of the Microscopical Society of London was continued under that name until 1866, when a charter of incorporation was granted, and the society, receiving the patronage of His Royal Highness the Prince of Wales, became the "The Royal Microscopical Society."

Former notices have frequently called attention to the unique character of the "Journal of the Royal Microscopical Society," which, unlike most learned societies, does not confine itself to the publication of its own transactions, but gives a very complete abstract of all that is taking place in its own departments of science. It will suffice to say that the present volume is fully equal to any that have gone before it, and bears testimony to the activity of the society and the energy of the editor and his talented staff of assistants. The volume is well indexed, as is the case with the whole of the present series.

Considering the great extent of the past publications of the society and the valuable matter contained in them, it is to be hoped that they may some day be rendered more easy of reference by the publication of a general index.

Natural History Sketches among the Carnivora, Wild and Domesticated, with Observations on their Habits and Mental Faculties. By ARTHUR NICOLS, F.G.S., F.R.G.S. London L. Upcott Gill.

WITH this work we are not quite satisfied. Above two-thirds of the whole are devoted to dogs—a somewhat thread-bare subject, —except from a psychological point of view. Twenty-eight more pages are bestowed upon the domestic cat, leaving only forty-three for all the wild carnivora, about which there is greater need for further accurate information. The author has evidently enjoyed very extensive opportunities for observation. He places on record too a goodly number of interesting facts, though he seems to regard the animal world rather with the eye of the sportsman than of the true naturalist.

His accounts, like all others, of the size of the Bengal tiger are of necessity vitiated by the absurd practice of tiger-hunters, of measuring their slain opponents from the tip of the nose to the tip,—instead of to the root of the tail. This custom renders the recorded dimensions valueless for indicating the real size of the animals.

Reading further, we find a reference to the abominable crime of tiger preserving. We may laugh at, whilst we regret, the folly of the Hindoo peasant who holds the tiger in superstitious reverence. But the civilised (?) European who spares the cubs of this enemy of man that he may afterwards display his courage and skill in shooting them when mature stands on a yet lower level, and is constructively a murderer. Surely the necessary extirpation of the tiger might be much facilitated by the use of poisoned bullets.

A strange fact concerning the leopard is mentioned on the authority of Sir Emerson Tennant. They have, in Ceylon at least, a peculiar fancy for the flesh of persons suffering from small-pox, by the specific odour of which, they are, it seems, strongly attracted.

Mr. Nicols seems to have come into unpleasantly close contact with the skunk in South America, and describes his sufferings on the occasion most graphically. He estimates the distance to which this animal can eject its dreadful secretion as fully ten feet. The common assertion that the mungoos is endowed with a special immunity from the venom of the cobra, or that it has recourse to some antidote, he disproves by reference to an actual experiment, which, as it was made with a scientific object, will be in certain quarters ranked amongst "orgies of diabolism."

The author quotes the statement made by Mr. Lawson Tait (in a paper read before the Birmingham Philosophical Society in 1883), that no other animal but the cat is subject to congenital deafness, and only those that are white are so affected.

This assertion was made too hastily. Dr. S. W. Burnett gives two instances of dogs deaf from puppyhood—one of them, moreover, not white but yellow.

Mr. Nicols denounces, not unjustifiably, the numerous persons who go off for a month or more to the seaside, leaving an unfortunate cat to starve or thieve. The number of these homeless cats is, in London, very considerable. On this subject he writes: —"Here is a clear field of action for the opponents of experiments upon living animals for the purpose of physiological research. Without a doubt more cats die annually in London of starvation than in all the physiological laboratories in the world, and they die a terrible death in consequence of the selfishness of those who are responsible for their well-being. Unfortunately, however, the case of these tortured cats does not present features which lend themselves to sensational or picturesque effects in

advertisements and pictorial wall-posters, and would not either arrest attention or draw subscriptions."

This appeal might shame some of our Bestiarians were they consistent in ought save inconsistency.

Although a cynophilist, or even as our contributor, Frank Fernseed, would term him, a cynolater, the author is more reasonable than some of the fraternity. He admits that the barking of dogs is a rampant nuisance and a "source of serious distress to brain-workers, and of imminent danger to the sick." He considers that "there ought to be a more prompt method of restraining the offending owner from inflicting the barking-torture upon his neighbours than is now obtainable." He owns that remonstrance with the owner is "generally met with insult, always with indifference.

But whilst fully aware that no man has a right for his private gratification to inflict such serious annoyance upon his neighbours, we cannot agree with Mr. Nicols that it is only chained dogs which make day and night hideous with their yelps and howls, and that they might be cured by allowing them more exercise. Going along Tottenham Court Road we were once obliged to turn aside into Gower Street because a little dog persisted in running yelping after every passing omnibus. More than once we have had to get out of a tram-car before our journey's end because some dog-owner had taken his seat in the vehicle, whilst his "base tyke" ran along by the side of the horses, barking incessantly.

The following passage is certainly outrageous:—"A human being who has not at some period of life enjoyed the friendship of a dog has missed one of the most humanising of all influences. Almost all the best men and women I have known were indebted to association with their dogs for much of that which is best in their character and disposition." Our experience and observation lead us to a very different conclusion.

Museums of Natural History. A Paper read before the Literary and Philosophical Society of Liverpool, by the Rev. H. H. Higgins, M.A. Also a *Phylogenetic Scheme of the Pedigree of Animals and Vegetables.* By Prof. Herdman. Liverpool: D. Marples and Co.

Were we to refer to every part of this pamphlet which richly deserves notice our critique would be bulkier than the treatise itself. Eschewing therefore all preliminaries, we perceive that the author divides visitors to Museums into three classes,—Students, Observers, and Loungers. The former, whom he approximately estimates at 1 to 2 per cent of the total, are those

who come with a definite purpose of improving their knowledge of natural productions, or, as it might be put, who seek the solution of questions which have occurred to them during reading or reflection.

The observers, who may reach 78 per cent, have no conscious, definite purpose, but "fix their attention with more or less intelligence on the objects displayed." The loungers reach, in Liverpool, 20 per cent, though in South Kensington they would doubtless be relatively more numerous.

The author concludes that "observers are more numerously attracted by the birds than the invertebrate animals. These proportions are reversed in the case of students."

The first part of the pamphlet closes with a recommendation for curators to organise. The following quotation from the late Prof. Stanley Jevons should never be forgotten:—"I venture to suggest, in conclusion, that the best possible step which could now be taken to improve the museums of the United Kingdom would be the constitution of a Museum Association on the lines of the well-known Librarians' Association. If the curators of all the public museums would follow the example of other professional bodies, and put their heads together in a conference, they might evolve out of the existing chaos some unity of ideas and action. At any rate they would take the first important step of asserting their own existence. There have been enough of Blue-books and Royal Commissions, and we have heard too much of what 'my Lords' have got to say. Let the curators themselves now speak and act, and let them especially adopt as their motto—Union, not Centralisation." Admirably said; but in all museums which are in any way connected with the Science and Art Department, the motto will be—Centralisation, not Union. Too often, also, attempts at professional organisation have resulted mainly in the establishment of a new set of examinations!

In his secoud part Mr. Higgins discusses "Museum Desiderata." He complains, with justice, that "many museums, in which the collections are fairly adequate, are rendered almost worthless to the public by deplorable deficiencies in the naming of the specimens: either the labels are inaccurate or altogether absent, or the ink has faded, or the writing is small and illegible; or the vibrations set up by the feet of visitors have severed specimens and their names into a most perplexing remoteness; or the objects are crowded, overlapping each other and concealing the names; or the label omits the locality where the specimen has been obtained."

In large families, containing many genera, the matter is still worse:—"Where the group begins and where it ends, what characters bind it together, what are its neighbours, and what the habits of life distinguishing its constituents, might be matters of complete indifference in some museums." In short, the

author very sensibly recommends, as a means of rendering the museum instructive, the use of conspicuous tablets calling attention to the life-history, affinities, and geographical distribution of the groups. The dusty, neglected look of the specimens is another legitimate cause of complaint.

Mr. Higgins denounces also a piece of vulgar obtrusiveness which we, too, have remarked with high displeasure. "A friend recently informed me that he saw in a museum, representing the regard for natural science in a wealthy county, a glass-case containing, together with specimens of natural history, a *remarkably small pair of breeches* worn by a foreign nobleman who had not long before resided in the district." Any comment on this absurdity would be an anti-climax. Hence Mr. Higgins is guilty of no paradox when he remarks that it is "the chief duty of the managing committee to keep such things out of their museum."

The author further rightly considers that no museum is complete without a biological laboratory, which should be near to, though not containing, the marine and fresh-water aquaria. The laboratory should be the receptacle for all specimens which cannot be properly examined without the aid of the microscope.

In the section dealing with museum arrangements Mr. Higgins admits that "if a genealogical tree were traced upon the floor, and table cases with glass tops for typical specimens were put in places indicated by the furcations of the classes, an exceedingly interesting appliance for giving instruction would thus be constituted." At the same time he is fully aware that to carry out this plan would require a very large space; not to speak of the difficulties arising from our hitherto imperfect knowledge of the phylogeny of animals.

The lack of space and funds is also the reason why even our great national museum has not yet attempted to form, along with its systematic collection, a second zoo-geographical collection, giving the leading features of the fauna of each country.

We find next a sketch of some of the relations in which invertebrate groups may be illustrated in a museum:—

"1. General life-history, including such information pertaining to the group as may serve to distinguish it from allied groups. This illustration may take the form of a tablet, printed in large type.

"2. The body of the group, consisting of specimens typical of the families, genera, and species constituting the group, preference being given to the most beautiful and most significant forms.

"3. British species representative of the group.

"4. Fossils showing the earliest appearance of the group in geological time.

"5. Specimens and anatomical preparations of members of the group preserved in liquids.

"6. Specimens of nests and habitations, galls and their tenants, eggs and egg-cases, webs and tissues; larvæ and pupæ; timber and stone pierced by molluscs, Crustacea, and insects.

"7. Examples of mimicry; of protecting colouration of unusual contrast between male and female of the same species; malformations, &c.

"8. Extended series of species and varieties belonging to the group, to be seen on application to the curator.

"9. Economic products of the group used in manufactures and arts. [Would not this department belong rather to a technological or industrial museum?]

"10. Models, drawings, diagrams, &c., of the anatomy and embryology of animals belonging to the group.

"11. Schedule indicating the systematic position of the group in the sub-kingdom to which it belongs.

We surely need not bring any formal proof that a museum embodying these features would be far more instructive to the student and the observer than anything which has yet been realised.

Passing over much suggestive matter we come to the author's remarks on the British Museum in its splendid place of exile. Following upon his first impression "how vast a work has been done!" comes a second, "at least equally strong, how much remains yet to be done! And a concluding conviction might perhaps follow—how much has been left desirable which can never be done, or only with extreme difficulty, in the present building. Whatever may be the architectural merits of the edifice very much has been sacrificed to them."

We must beg leave to expand this remark. The impression prevails among outsiders that in the new building in Cromwell Road—why not better Darwin Road?—ample space for every department is secured. This is quite a mistake. Nothing can be a piece of greater folly than to sacrifice the efficiency of such a place to architectural display.

> "The walls are thick, the servants thin,
> The gods without, the devil within,"

has been long ago pronounced to be the common condition of museums. To some extent these lines are applicable to the new building.

The curators are too thin in point of numbers. The extensive department of Entomology, for instance, is committed to the charge of *three* curators only! We know these gentlemen personally, and can testify to their zeal and efficiency; but they are too few.

Mr. Higgins, preferring a plain building with ample space to the palatial structure in question, writes:—"I fear the West End

requires to be educated before it would endure such a structure placed permanently so near Belgravia." Precisely; and this is one of the many reasons why the Museum should never have been taken to South Kensington.

One of the reasons alleged for this ill-starred removal was to give sufficient room for specimens of whales, &c. But where are these animals placed now? In a hall where the view is broken by massive brick pillars!

Mr. Higgins's pamphlet must commend itself to all sincere votaries of natural history, and we hope that all such will give it a careful reading.

A Treatise on Gold and Silver. To show a Chief Cause of Present Depression in Trade, and Shrinkage in Value of all Produce and Property. By GEORGE O'BRIEN. Dedicated to the Right Hon. W. Ewart Gladstone, M.P. London: Mining Journal Office.

THE object of Mr. O'Brien is, firstly, to inquire whether the amount of gold in circulation throughout the world is sufficient for the requirements of commerce, and whether we can increase the supply? For this purpose he enters upon a close examination of the auriferous districts throughout the world. This survey is not, it will be observed, such a one as could be got together by a mere reader. The author is practically acquainted with the natural distribution of gold in such important districts as California, Nevada, the Wynaad, and, we believe, Peru and Bolivia. As gold, so far, has been found under identical conditions wherever it occurs at all, we may trust his judgment even concerning regions which he has not personally explored. He shows that our stock of gold has been chiefly derived from alluvial deposits, which in course of time have become much impoverished, if not exhausted. Many of these deposits have been worked profitably only by means of slave-labour, and now, in spite of all the devices of modern science, the output is gradually falling off.

It is a somewhat singular circumstance that the elements of highest specific gravity, such as gold, platinum, and iridium, should exist chiefly in superficial deposits. We can only account for this fact by supposing that they were primordially deposited, alike in profound and in superficial strata, in traces too minute for profitable working, but that these particles have been liberated during the weathering of the surface formations, and have become agglomerated.

Beginning with that collapsed bubble, the Wynaad, on which

we learn that above three millions of British capital have been fruitlessly spent, the author passes on to the other reputed auriferous districts of Asia. The produce of China and Japan he estimates at about £750,000 sterling yearly, and points out that as the people of those empires are very skilful in gold-finding and washing, the probability of any important deposits having escaped them is not great.

The yield of the Russian empire shows a gradual, steady decline. The net produce in 1877 was only £661,500, and since then it has continued to fall off.

Africa still yields about £1,300,000 annually, Here, also, there is every probability that the richest alluvials have been ransacked and washed out. The different regions of South America have been at one time enormously productive; but now they, for the most part, exhibit the same picture as the Wynaad and the auriferous districts of Siberia. During the (approximately) two centuries from 1691 to 1884 Brazil has yielded gold to the extent of £150,000,000; its present output is under a quarter of a million. New Grenada and Venezuela yield about £200,000 yearly. Mexico, too, has greatly fallen off.

Even California, Nevada, and certain adjacent States of the North American Union, which in the thirty years from 1849 to 1879 contributed £327,000,000 to the world's stock of gold, are not now as productive as in those days. In 1881 the output of all the States combined had fallen to £4,700,000, with a prospect of further decline. In British North America the production of gold has often been close upon a million yearly, but is now falling off. In Australia the yield does not reach the half of its quantity in 1867.

In short, our author sums up the total yield of gold throughout the known world at £14,000,000, and this with little or no tangible prospect of increase. It is further shown that of this small yearly total £9,000,000 are consumed in jewellery, gilding, &c., and that no small portion is, especially in America, buried with the dead in the fastenings of artificial teeth. Thus for the purposes of commerce there remains only the relatively small sum of £5,000,000.

To meet this evil the author proposes the adoption of a bimetallic currency, or, in other words, the recognition of silver as a legal tender. We are no commercial or economical authority, but to us his arguments seem sound and his proposal eminently judicious. He points out the significant fact that the epoch of the profuse gold yield in California and Australia, from 1849 to 1879, was a time of unexampled commercial prosperity,—a time when national prosperity was increasing by "leaps and bounds." On the other hand, the present stagnation of trade, whatever other causes may concur, is certainly connected with a falling off in the supply of that metal which the modern world has chosen for its sole circulating medium.

The Unity of Matter: being Thoughts on the Nature, Weight, and Expansion of Gases. By G. T. CARRUTHERS, M.A.

THIS treatise will scarcely fulfil the expectations which chemists will draw from the title. Any evidence, direct or indirect, that all matter is derivable from some one elementary substance they would eagerly welcome; but this is so far not forthcoming. The author certainly accepts material unity. He writes:—"If there is a Creator of matter are we to suppose that He called into being, one by one, all these elementary forms, and some of them in such minute proportions to the immense masses of others that the reason of their existence becomes as great a mystery as their creation?" With the view here expressed most chemists will agree. But in a following passage they may justly complain that their notions are not fairly represented; for we are told that moderns "find no difficulty in accepting the idea that there are sixty or seventy primitive forms, each having inherent and marvellous properties of its own."

Such, we submit, is by no means the case. Few, if any, chemists now regard the elements as other than bodies which so far we have been unable to resolve into anything simpler. The primordial unity of matter they accept as firmly as does Mr. Carruthers. They do not refuse to "accept the notion of the unity of matter because it is not supported by experiment." They look upon such unity as highly probable, though not proven, and they eagerly look out for convincing evidence, and will not be slow to accept such if found.

Mr. Carruthers suggests that chemists may perhaps think as follows:—"There are sixty or seventy centres of creation or centres of matter in the universe. The vapours issuing from these fill space, and so interpenetrate each other that the planets appropriate and condense proportions of them all as they proceed in their orbits. Thus the Earth, the abode of oxygen, steals its nitrogen from Mars, which is ruddy with its nitric peroxide; Venus shines bright with its inherent carbon and the Earth's oxygen, while the Sun is the great source of hydrogen."

We question if this speculation has ever before been propounded. It certainly presents at every step suppositions which are, to say the least, unproven.

Mr. Carruthers considers that, in seeking to decompose the elements, we have kept "blundering on, trying to simplify that which is already simple; but it may be wiser to try to arrive at the unity of matter by some other process. Let us then, leaving the simple forms, take one of the so-called compound forms of matter, and, instead of splitting it up into its elements, try rather to raise upon it all other elements. Let us, for instance, take water. We know that if we place in water the terminals of a battery, two so-called simple substances will issue from it:

now why may not these be only two other forms of watery matter? It is possible that they may each contain exactly the same constituents as water, but have different properties because they contain the watery constituents in widely different proportions." And the treatise concludes with the words—"Until we know more it is well to contemplate the possibility of water being the only simple in the world, and the original matter of the universe."

Yet the author, in the passage quoted above, speaks of water as having "constituents,"—identical with those of oxygen and hydrogen, but in different proportions. In a further passage he supposes that "water is formed of some vapour and some absorbing solid"—and yet simple! Here, then, oxygen and hydrogen are set aside in favour of two hypothetical bodies as unseen and unproducible as the andronie and thelyke of Winterl.

Water has been subjected to innumerable experiments, but nothing save oxygen and hydrogen has ever been obtained from it. Hence we may well question the wisdom of "blundering on" in this direction. By whatever process we decompose water the results are qualitatively and quantitatively the same: hydrogen and oxygen, free or in combination, are produced; and from such hydrogen and oxygen, in the same proportions, water is again obtained. If we set aside this double evidence we reject analysis and synthesis as means for ascertaining the composition of any substance. Thus it might be asked, Why may not potassium and oxygen be merely other forms of potassic matter? Why may not mercury and oxygen be merely other forms of mercuric oxide matter? In short, we pronounce experimental inquiry a sheer impertinence.

The author's further reasonings contain much in which we can find nothing definite and tangible. If he is ever able to produce any experimental fact proving the origin from pure water of anything save oxygen and hydrogen, he may rely upon our respectful attention.

First Annual Report of the Bureau of Ethnology to the Secretary of the Smithsonian Institution, 1879-80. By J. W. Powell, Director. Wasington: Government Printing Office.

The interest taken in ethnology in the United States is a healthy feature. Here is a subject totally unconnected with money-making, and pursued, if at all, from the pure love of truth. The goodly volume before us contains, in addition to the Directors'

Report, papers on the evolution of language, on the mythology of the North American Indians, on the Wyandot Government, and on limitations to the use of some anthropologic data, all by Mr. J. W. Powell. There are, further, a study of the mortuary customs of the North American Indians, by H. C. Yarrow; studies in Central-American picture-writing, by E. S. Holden; an essay on the cessions of land to the United States by Indian tribes, by C. C. Royce; sign-language among North-American Indians, by Garrick Mallery; a catalogue of linguistic MSS. in the library of the Bureau of Ethnology, by J. C. Pilling, and illustrations of the method of recording Indian languages, by J. O. Dorsey, A. S. Gatschet, and S. R. Riggs.

Some of these papers merit an examination in detail,—at greater length, indeed, than our available space will allow. In the essay on the evolution of language Mr. Powell discusses what he calls the "grammatic processes," by which an original small stock of words has been combined and modified. These processes are: combination, vocalic mutation, intonation, and placement. The author next discusses the differentiation of the parts of speech. He insists that all paradigmatic inflection in a civilised tongue is a survival of a barbarous condition. All such inflection requires unnecessary thought. In the clause *if he was here*, *if* fully expresses the subjunctive condition, and it is quite unnecessary to express it a second time by using another form of the verb *to be*. And so the people who are using the English language are deciding, for the subjunctive form is rapidly becoming obsolete, with the long list of paradigmatic forms which have disappeared."

He further writes:—"Every time the pronoun *he*, *she*, or *it* is used it is necessary to think of the sex of its antecedent, though in its use there is no reason why sex should be expressed, say, one time in ten thousand. If one pronoun non-expressive of gender were used instead of the three, then in 9999 cases the speaker would be relieved of an unnecessary thought." Judging by such criteria he considers that the English language stands alone in the highest rank.

The same author in his sketch of the mythology of the North American Indians studies the genesis of philosophy. He holds that there are two grand stages of philosophy—the mythologic and the scientific. In the former of these stages all phenomena are explained by analogies derived from human experience. "By subjective examination discovering in himself will and design, and by inductive reason discovering will and design in his fellow men and animals, he extends the induction to all the cosmos, and discovers in all things will and design. All phenomena are supposed to be the acts of some one, and that some one having will and purpose. . . . The simple is compared with and explained by the complex." In the second great stage phenomena are supposed to be the children of antecedent phenomena. . . . Man,

with the subjective phenomena gathered about him, is studied from an objective point of view. . . . Thus the complex is studied by resolving it into its simple constituents." Here we find it incidentally remarked that "blue and green are not differentiated, for the Indian has but one name for the two." But are we thence to infer that his perceptions of colour are not differentiated? We civilised men have not names for one-tenth part of the colours which we can perceive and distinguish.

According to Mr. Powell the mythologic philosophy, has four sub-stages. In the lowest of these, *hecastotheism*, everything is alive and everything is a god.

In the second stage, zootheism, animals are gods. "No line of demarcation is drawn between man and beast." We may here remark that this very line of demarcation afterwards drawn in the following stage became one of the cardinal errors which Evolutionism has to eradicate.

In the third stage the powers and phenomena of nature are personified and deified. Thus there is a sun-god, a moon-god, &c. This stage Mr. Powell names physitheism.

Lastly, mental, moral and social attributes are personified and deified. This stage, in the author's system, is psychotheism. By a process of mental integration it developes in one direction into pantheism, and in the other into monotheism, according as the intellectual or the moral element predominated in the minds of the men by whom the process of evolution was carried on. It is a curious fact that the rise of psychotheism appears to have been conincident in time with the invention of an alphabet.

Certain outgrowths of the mythologic philosophy are next considered. The first of these, which the author designates "ancientism," is the belief that "yesterday was better than to-day, and that the ancients are wiser than we."

Another of these outgrowths is affirmatisation,—the propagation of opinions by affirmation. What has been often or always said,—what is said by everyone,—must be true.

Very few people will now uphold "ancientism." But it may be asked whether its modern substitute "progress" is not a mistake equal and opposite. What is new is no more necessarily true than what is old. Evolution is often of a retrograde character and leans to degeneration.

In the paper on the mortuary customs of the Indians we find that certain tribes have the abominable habit of burying their dead under springs, or throwing them into lakes and rivers. An African tribe, the Obongo, bury their deceased friends in the bed of a stream which is temporarily diverted from its normal course.

In the essay on sign-language we find it recorded that Prof. A. Graham Bell succeeded in causing a terrier to form a number of the sounds of our letters, and to utter distinctly the words "How are you, grandmamma?" We dissent from the author's

opinion that the brain of the parrot is not sufficiently developed to admit of its vocal powers being used significantly. We have personally witnessed decisive instances to the contrary.

Mineral Resources of the United States. By ALBERT WILLIAMS, Jun. Washington: Government Printing-Office.

ONE of the most interesting sections of this book is that on the Divining-Rod, by R. W. Raymond.

Concerning this instrument and its value the most conflicting opinions prevail among its votaries. Not only are its shape, size, and mode of use matter of dispute, but on its range of efficacy there is no agreement. "The immense literature of the divining-rod shows nothing more clearly than the boundless contradictions and confusions of its advocates and professors." In antiquity the rod was used mainly for moral purposes, that is for the detection of criminals, the foreknowledge of future events, &c. In the middle ages its employment was restricted to the discovery of hidden treasures, of veins of ore, springs of water, &c., whilst its former function was condemned by the Church. Towards the end of the seventeenth century its moral efficacy was again asserted, and in the eighteenth it was once more relegated to the material sphere. That its advocates occasionally fell under the censure of the Church is very intelligible, though this does not seem to have occurred as long as they confined their operations to the detection of material objects. Its use was, indeed, sometimes accompanied by rites of a magical character. Others held it essential that the rod after being cut must be consecrated by being placed in a bed along with a newly baptised infant, whose name it received. The author quotes from Gaetschmann the following formula addressed to the rod:—"In the name of the Father, and of the Son, and of the Holy Ghost I adjure thee, Augusta Carolina, that thou tell me, so pure and true as Mary the Virgin was, who bore our Lord Jesus Christ, how many fathoms it is from here to the ore?" The rod was then expected to dip as many times as the ore lay fathoms deep.

It is undeniable that "dowsers," as they are called in Cornwall, have often been successful, especially in discovering deposits of ore, subterranean water-courses, &c., in districts with which they are familiar. But even in such districts their failures are many. When their power is put carefully to the test, it generally fails. "The most distinguished expert in this art on the Pacific coast . . . was invited to inspect a metallurgical laboratory containing a large amount of gold in coin and bullion. After this inspection he was brought again, blindfolded, into the laboratory, and re-

quested to point out the metal with his rod. But he could find nothing, though during his perambulation the point of his rod was frequently within an inch of thousands of dollars." But he had an excuse at command. "When the bandage was removed from his eyes and he was shown that all the coin had been put in the fire-proof safe, while all the bullion had been fastened by wire to the underside of a writing-table, he claimed that his rod had been diverted by the immense amount of treasure in a bank half a block distant!"

The author gives other instances of failure and of fraud among these diviners. He then sums up the matter in the following series of propositions:—

"The material, consecration, astrological relations, and ritual formalities of the rod are entirely irrelevant and indifferent to its efficacy. The rod is entirely inert, unless in the hands of a human operator, and . . . is merely an index revealing in visible results the peculiar inward sensation of the diviner. The favourite and most convenient form of the rod (Y) is one which promotes involuntary muscular movements, and permits deception.

"The uses of the rod for discovering moral qualities, restoring missing landmarks, tracing stolen property, predicting the future, or even settling the orthodoxy of theological dogmas belong to charlatanry and superstition.

"The agency of demons we may also set aside, as a view outgrown if not disproved. [This can scarcely be asserted with as much confidence now as was the case half a century ago.]

"The application of the rod to the discovery of metals, coal, buried treasure, &c., is shown abundantly to be chimerical. The rules and methods, as well as the asserted performances of its professors, contradict each other, and innumerable failures and exposures have justly covered their pretensions with ridicule.

"The transparent humbug of locating oil-wells with the rod needs no comment.

"The case is somewhat different with the discovery of springs, and (since ore-deposits always have been the channels of springs) of ore-deposits. Here we have much stronger and more abundant evidence in favour of the rod, and here, in my judgment, there is a residuum of scientific value."

On this head Mr. Williams makes use of the following judicious remarks:—"There is undoubtedly a practical science [art] of discovering mineral deposits and springs. The most skilful prospectors can scarcely explain how they decide upon the place where they dig; and yet, though they are by no means always successful, it is certain that they are more successful than the inexperienced. . . . The practical explorer . . . has a science of his own which affects his mind by the principles of association and memory. He recognises in a new locality the tokens that he has been accustomed to associate with a rich gulch or an

abundance of pay-quartz. This practical skill is almost unerring *within narrow limits. Under new conditions it breaks down.*" We could wish that these considerations had come under the notice of Mr. S. Butler before he wrote a passage to prove the inferiority of the mining engineer to such prospectors! But Mr. Williams continues:—"Some of the most absurdly foolish gold-mining enterprises I have ever known have been set on foot by old Californian miners, who, returning to their former homes east of the mountains, have said at once of some ravine or hill-side that it was just the place for gold."

Every close observer will admit, as does the author, that there are many tokens by which the presence of water underground may be inferred. And the hydroscopist is really guided by these signs, and merely fancies that he is obeying the indications of the rod.

The bulk of the work before us consists, however, of a most elaborate account of the metallic ores and other valuable minerals known to exist in the United States. Under "Vanadium" we find the following strange passage:—"Vanadic salts are extremely valuable, and are used principally as a mordant in the manufacture of the finest silks." The chief use of vanadium compounds is in the development of aniline black upon cottons.

The Dynamo: how made and how used. A Book for Amateurs. By S. R. Bottone. London: W. Swan Sonnenschein and Co.

The purport of this book is explained in the title, brief as it is. The author, addressing himself to amateurs, gives exceedingly plain, clear instructions for the manufacture of small dynamos. He has in view the construction of such machines only as can be worked without power, and may "replace a battery of eight or ten cells without the disagreeable concomitants of changing acids and cleaning plates."

Here, of course, there is room for variety of tastes and aptitudes. There are many persons who would find the care and management of a battery far less disagreeable and difficult than the construction of a dynamo, even by the aid of Signor Bottone's able instructions. But for those who have mechanical taste and skill the dynamo will doubtless be preferable.

The illustrations of this work are numerous, well executed, and intelligible.

Notices of a large number of books stand over for lack of space.

In the critique on Dr. Willoughby's "Hygiene: its Principles as applied to Public Health," which appeared in our issue for December last (p. 744), the author is inadvertently represented as pronouncing "lentils the most nutritious as well as the most digestible of all forms of vegetable food." It should have been said "of all kinds of pulse."

CORRESPONDENCE.

*** The Editor does not hold himself responsible for statements of facts or opinions expressed in Correspondence, or in Articles bearing the signature of their respective authors.

NEO-PHRENOLOGY, OR HYLO-IDEALISM.

REVERTING to my letter in the January number of the "Journal of Science" on the sentient eye being the real source of light, transformed by its magic out of non-luminous tremors, may I be allowed to make the following short further explanation on this point? My position is the result of pure Physical Research, quite innocent of Metaphysics. And yet I am well pleased to be judged by the strictest rules of sound Scotch or German moral philosophy, which quite coincides with Modern Science, in eliminating Ontology, *i.e.*, true Œtiology, or the doctrine of first causes, from the province of human reason and nature. It seems now perfectly irrefragable that the domain of the Absolute is quite unknowable, and that human knowledge is strictly confined to the Relative and empiric sphere. Dr. Brown in his work on "Cause and Effect," Kant in his "Passage from Metaphysics to Physics," and von Hartman, the present dominant authority in Germany, in his "The Unconscious from the Standpoint of Physiology and Darwinism," all tell the same tale. Now I hold that this Phenomenology quite forecloses Theology and all forms of Spiritualism whatever, leaving us face to face with Matter and Force (function) alone. *Nous* or Mind there is in Nature, but it can be nothing else than *our own* mind, and hence all worship of that *Nous* must be Self-Worship. No Brain can ever escape from its own functions. Just as easily may body run away from its own shadow. And in the hylo-ideal sense it is really the Universe, as mirrored in Consciousness, to which we have alone access, so that the *To Pan* is strictly a manufacture of our own mind, *i.e.*, Brain,—all knowledge being thus really a form of cerebral symptomatology. Organ, as has been acutely pointed out to me by the Editor of this Journal, really means *Werk zeng*, *i.e.*, work-generator, and it is hence absurd to postulate force, function, or symptom as antecedent to, or independent of, its generator. This view gets quite rid of Mysticism and Animism, the deadly banes of Science, the two being mutually exclusive, as well shown by Dr. Priestley, *Phlogiston* delusion, which

rendered scientific Chemistry impossible. While one shred of ontological occultism vitiates the judgment of its votaries, true empiric Science must ever be heavliy handicapped by Gorgons, Hydras, or Chimeras dire, and can never have free scope for its beneficent mission to humanity.

ROBERT LEWINS, M.D.

GRAVITATION.

IN the "Journal of Science" for November, 1884, a theory of Gravitation is put forth, which is based upon the assumption that there is no universal ether. The attempt at explanation, however, fails, inasmuch as, if even were the postulates granted, the result intended does not become self-evident. Gravitative force is inherent in every particle of matter; and it follows that if we rightly understood the constitution of dense particles we would see that their gravitative forces or tendencies result from their very existence.

It is true that from the time of Newton to the present the problem of reducing the phenomena of gravitation to a simple mechanical conception has completely baffled the greatest scientific intellects. Still a postulate can be given, which if admitted will furnish all that is required, and there may be minds to whom its statement will not be unwelcome.

When we ask the question as to what is necessary to produce the phenomena of gravitation, the answer at once comes that every particle of matter shall virtually be the centre of lines of uniform static tension or pressure,—extremely weak, but universal in extent. If, then, we postulate a universal perfectly elastic ether, and all bodies to be condensed ether originally produced by a compressive force which still continues and maintains the primal concentric strains which produce them, the requisite condition would be reached, and gravitative action would necessarily follow. For every material particle would be the centre of an ethereal stress, the force of which would be in proportion to its mass, and as sensible matter is immeasurably small in amount as compared with the pure ether, the stresses centreing in every body, although universal in extent, would be proportionally weak, and consequently such would be the manifested tractive force. The tendency of bodies to come together would thus really be the tendency to equilibration of the ethereal strains, and which could only be reached by all dense matter coming together and forming one centre of a universal sphere of stress; the only mode of counterbalancing this tendency being the force of tangential motion, such as we see in all cosmic systems. The apparently greater density of the ether within and around dense matter, as deduced from the phenomena of refraction, also favours this view.

Of course this principle of the conservation of matter lies outside the range of physical science, and requires the constant operation of a power above nature; but there is nothing miraculous about it, in the sense of deviation from natural experience. It is intelligible, and offers hindrance to no mode of investigation. I have taken my postulate from the scientific theologian Swedenborg, who claimed that it was revealed to him that the creative energy thus flows into nature, and reaches its quantitative limit in the production of dense and inert bodies, from whence it begins to operate formatively or organically. But other philosophers have held that the conservation of energy is simply the maintenance of the primeval creative force, and that the universe would no longer exist were that force withdrawn.

It should be added that there has been no other mechanical conception of dense matter as *necessitating gravitative action* ever been put forth, even as being maintained by a power above Nature.

WM. DENOVAN.

VARIABLE STARS.

I SHALL be glad if you will allow me to rectify an error in my paper on "Variable Stars. On page 40 you will find that I have stated that the temporary star observed by Tycho Brahé and the star in corona were both situated close to the Milky Way. Clearly enough, if a star is situated in Corona it cannot be nearer the Milky Way than one-half of the Sun's distance therefrom. The mistake occurred as follows:—I had written a paragraph on the Star of 1572, as it appears in the "Journal of Science," and also a paragraph on the Star which appeared in Aquila, A.D. 389, and which was for some time as bright as Venus, eventually disappearing, as others have done, completely. I then continued, as in the article (page 40, line 11 from bottom), "Both these stars, &c."

It struck me afterwards, however, that the instance of the star in corona would be more suitable for purposes of illustration, so I struck out that part relating to the star of 389 in favour of that of 1866, but unfortunately omitted to alter the following paragraph.

On page 34, 13th line from bottom, "analytical" is a printer's error. It should be "analogical."

Readers will greatly oblige by taking note of these corrections, the necessity for which I much regret.

J. R. SUTTON.

NOTES.

We learn with satisfaction that Mr. A. Anthony Nesbit, F.C.S., is about to offer himself as a candidate for the position of Consulting Chemist to the Royal Agricultural Society, vacant by the death of Dr. A. Voelcker. Mr. Nesbit is the son and successor of the late J. C. Nesbit, F.G.S., F.C.S., &c., who up to his premature death was considered the most eminent agricultural chemist in England. Mr. A. A. Nesbit has carried out with success many delicate chemico-physiological researches, for accounts of some of which we may refer to the "Journal of Science (iv., pp. 430, 565, and v., p. 304). Mr. Nesbit has our best wishes for success in his candidature.

At a congress of French learned societies, to be held at the Sorbonne in the course of this year, there will be examined the mode of topographical distribution of each animal species inhabiting the coasts of France; the regions of the French rivers frequented by each species, fish, crustacean, or mollusk, noting the times of arrival and departure, if not stationary, and the time of spawning; the periodic phenomena of vegetation at the epochs of the arrival and departure of birds of passage, at the date of the appearance of the chief species of insects hurtful to agriculture, &c.; the relations between the varieties of zoological or botanical species, and the conditions in which the representatives of each live (altitude, dryness or moisture, &c.).

On October 25th, at 7 a.m., the coldest point in Europe was in the neighbourhood of Paris, where a temperature of $-0{\cdot}5^{\circ}$ was registered. At Haparanda, near the head of the Gulf of Bothnia, the temperature was $+4{\cdot}5^{\circ}$, as also at St. Petersburg and Moscow. In the north of Scotland, and over a great part of the North Sea, the thermometer marked upwards of 10°.

Prof. C. V. Riley (American Association) has traced the habits of *Chlænius impunctifrons* from the egg upwards. The eggs are laid singly, in cells made of clay or mud, on the under surface of leaves.

An International Exhibition of Animals is to take place next year at Buda-Pesth.

At Bhosawul, in India ("Ciel et Terre"), there fell in the space of twelve hours, in the night between January 1st and 2nd, 1883, 385 millimetres of rain, or about 15 inches.

MM. L. Hermann and A. von Gendre ("Pflüger's Archiv.") have made experiments on the electromotive properties of hen's eggs during incubation. If an egg is taken out of the incubator, carefully opened, and if conductive points are introduced into the germinal area in such a manner that one touches the body of the embryo, whilst the other is in contact with any point of the yolk, or even of the white of the egg, a current is obtained which passes regularly from the yolk to the embryo, or, in other words, the embryo is positive to the yolk. The electromotive power may amount to 0·01 Daniell. It increases in the first days, at least as far as 80 hours, and then again decreases.

Certain scientific journals are now, so to speak, coquetting with Spiritualism. They will probably soon change sides, eat their own words, and display the usual indiscreet zeal of neophytes.

Mr. G. Makloskie (American Assoc.) shows that the tracheæ of insects have spiral crenulations, which have hitherto been mistaken for threads. The tracheæ transmit gases directly to the tissues without the mediation of the blood. They are not directly controlled by muscles, but their action depends on the successive production of a partial vacuum and on the condensation of the air.

It appears that Mr. W. E. Gladstone has been present at a *séance* with Mr. Eglinton, and has witnessed some successful psychographic experiments! Whether Spiritualism will henceforth take up a political character remains to be seen.

At a late meeting of the Sheffield Medico-Chirurgical Society Mr. C. Atkin exhibited a slug said to have been excreted alive by a young child, which had never received any other nourishment than its mother's milk.

Dr. C. S. Minot (American Association) read a paper on the skin of insects. It consists of three layers,—the cuticle, overlying the epithelium, below which is a sheet of connective tissue. The epithelium is homologous with the epithelium of other animals, and should be so called instead of hypodermis. The connective tissue should be called dermis. The cuticle of caterpillars consists of two layers, a thick and a thin one.

According to M. Urueta ("Union Médicale") cats are great destroyers of venomous serpents in Venezuela. If bitten they do not necessarily succumb.

At the American Association Dr. E. D. Cope read a paper on the Mammalian Affinities of the Saurians of the Permian Epoch.

"Ciel et Terre," in its monthly climatological review, notes that the rainfall has been below the mean in almost every month since January, 1883.

Prof. A. Hyatt (American Association) in a critique on the commonly received views on Heredity, gave the case of a man who resembled his mother on one side of his body, and his father on the other.

The "Kansas Review of Science" gives a long and elaborate argument to prove that the Romans colonised America. The evidence brought forward is merely etymological.

A "Bureau of Scientific Information" is being organised in the United States.

Dr. Chapman, in the "Westminster Review," speaks of the disappearance of birds during an outbreak of cholera as an established fact.

Mr. Cramer (Brooklyn Entomological Society) affirms that twenty-four hours after blowing the larval skin of *Papilio philenor* he has observed the organs of the mouth still moving as in life.

We regret to learn that "M.A. (Oxon)," of "Light," is suffering from the results of a serious accident.

"Light" is responsible for the following:—"I was sitting," said Lord Tennyson, "at Mr. Gladstone's, one side of the table, and Mr. Tyndall was at the other; Mr. Tyndall had been talking of 'God as a notion invented by poets and philosophers';—'Then leave it, Mr. Tyndall,' said Mr. Gladstone, 'to the poets and philosophers, and stick to your science.'"

Dr. Merriam ("Science") denies that the bite of the skunk normally occasions a peculiar kind of hydrophobia, known as *rabies mephitica*. He also controverts the notion that the "spike horn buck" is a distinct variety of the Virginia deer, and shows that they are merely yearling bucks with their first antlers.

"Science" writes that the American National Academy of Sciences is "the only Government organisation now existing, or which ever has existed, the members of which were required to give their services to the Government without charge whenever called upon." Our contemporary is probably not aware that in Britain scientific societies, though not Goverment organisations, are expected to give advice gratis to any Government Department which may need it.

M. G. Pouchet ("Comptes Rendus") has extracted from the evacuations of cholera-patients an extremely poisonous ptomaine. If a trace of this liquid is injected under the skin of a frog, death rapidly ensues, preceded by a remarkable slowness in the motions of the heart, and followed by the most intense rigidity.

M. F. Laur ("Comptes Rendus") calls attention to the coincidence between an earthquake felt at St. Etienne and a sudden fall of the barometer succeeding a time of high pressures.

M. Rochefontaine raises the following question :—If an animal is submitted to a Faradic current over a limited region, under what conditions will a contact with the fingers with some other part of the body produce a commotion in the experimentalist? The author concludes, from the contradictory results of his experiments, that it would be imprudent to found upon phenomena of this kind a method of distinguishing real from apparent death.

According to M. Forgola ("Ciel et Terre") observations made continuously during the last twenty-five years, at the Observatory of Pulkowa, present discrepancies explainable on the supposition of a progressive decrease of latitude at the rate of about 1" per century.

According to "Cosmos les Mondes" a personage occupying an eminent post in French diplomacy has written to an astronomical paper to ask "what planet had passed between the Earth and the Moon, so as to cause the recent total eclipse?"

It is significant that in the journal above quoted we find fourteen pages out of a total of forty-seven devoted to the art of war. What say the Peace Societies?

A writer in the "Truth Seeker" asserts that, so lately as five years ago, a woman was burnt to death in the province of Novgorod for alleged witchcraft.

B. Tacke ("Bericht. Deutsch. Chem. Gesell.") finds that, in the rabbit, considerable quantities of combustible gases are eliminated from the organism through the blood and the lungs. The quantity expelled *per anum* is much smaller.

A new metallic element is announced, by Prof. Welsky, under the name of Idunium. It occurs in native lead vanadiate.

M. G. Desrameaux has obtained a patent for a machine which, in a minute, can produce an absolute vacuum in a receiver of the capacity of 2000 litres.

M. le Goarant de Tromelin maintains that the mean temperature of the Northern Hemisphere is decreasing, whilst that of the Southern is increasing.

The author of "Ceylon, Ancient and Modern" has, at "Twickenham: printed by and for the Proprietor (privately), 1884," a comical little volume under the pronounced title "Anti-Darwin, or some Reasons for not accepting his Hypothesis. It opens thus :—

> "Poor race of men says the sceptical spirit,
> A fig for your 'primal fall.'
> Some graces ye may inherit,
> But the trace of the ape is over them all."

At the November meeting of the Royal Microscopical Society an improved form of Gas Microscope was exhibited by the inventor, Mr. Lewis Wright. The performance greatly surpassed in definition and rendering of colour anything that has hitherto been produced. In addition to objects specially prepared by Mr. Topping, several selected by Dr. Carpenter were handed to the exhibitor and successfully projected on the screen. The objective which has worked best is one of 8-10ths of an inch, made with larger glasses than is usual for microscopic purposes, and corrected solely for the purpose of projecting objects upon a screen. The field is flat, and the definition good to the circumference of the disc. No doubt still greater improvements will be effected, as the inventor has worked upon a new principle. Hitherto ordinary objectives have been employed, but although they give good images in the comparatively small fields used in photo-micrography, they are generally deficient in light and definition when very great amplification is attempted. The present advance will prove of immense value to lecturers in the demonstration of histological subjects, as exhibitions on the screen have been confined to photo-micrographs enlarged by a superior magic-lantern.

After a late tempest, about five hundred dead crows were found on the Norwegian coast, near Bergen. It is supposed that the birds had been at roost on the small rocky holms and had been suddenly overwhelmed by the storm. This is a comment on the notion that the lower animals have an instinctive foreknowledge of the weather.

Mr. E. T. Nelson, in "Science," gives an account of a pumpkin, freshly gathered and perfectly sound, which, when cut open, was found to contain seeds which had already germinated. The caulicles were from one to three inches in length, while some of the rootlets were over seven inches. The cotyledons, wherever free from the seed-covering, were green in colour, and spread so as to expose the growing plumule. In one case the second leaves were partly unfolded.

M. Chairy ("Comptes Rendus") concludes, after a long series of experiments, that the medium in which bacteria live has only a slight influence on the proportion of poison necessary to prevent their development or to destroy the spores. The mass of the bacteria existing in the medium has a marked influence. Chemical agents act the more energetically the more acid their character, which may perhaps be deduced from the fact that bacteria tend to render their medium alkaline.

According to G. Lindström a scorpion found in the Upper Silurian of the island of Gothland is the most ancient terrestrial animal yet discovered. Its four pairs of thoracic feet are pointed like those of the embryos of many other Tracheata and of animals such as Campodea. This form of feet does not occur in the fossil scorpions of the Carboniferous ages.

Sir Spencer St. John, who, having been for many years British Consul in Hispaniola, has enjoyed extensive opportunities for observation, finds that though up to the age of puberty the negro is mentally equal to the white, after that time he falls hopelessly into the background.

The mortality among chemists continues. Angus Smith, Kolbe, Voelcker, Wigner, and Vierordt have followed Dumas, Würtz, and Thenard.

An unknown writer, from Fiji, remarks that when flocks of terns and other sea-fowl rest upon the sea in great numbers the water becomes smooth, and there is "not a ripple to disturb them." This the writer ascribes to oil emitted by the birds.

At the Ischia earthquake there occurred a very decided case of "scare-cure." A woman who had been bed-ridden for months jumped up, saved herself by flight, and remained permanently cured.

According to M. Delaunay, robust children cross the right leg over the left earlier than do weaker ones.

M. de Varigny ("Revue Scientifique") denies, on the faith of careful experiments, that scorpions, if surrounded by fire, sting themselves to death.

A writer in "Les Mondes" revives the view that atmospheric ozone is antagonistic to epidemics.

An iceberg has been found in Davis's Straits, which must have floated from the mouth of the Lena, as it contained relics from the unfortunate *Jeannette*. It is conjectured that it must have traversed seas near the North Pole.

"Science" asserts that a considerable portion of the American people still believe in witchcraft, and that "our school system, with its imperfect scientific training, makes no efficient battle against these pernicious relics of the past."

Dr. Szpilmann ("Berichte Deut. Chem. Gesellschaft") finds that air, and still more pure oxygen, promotes the multiplication both of the bacilli of anthrax and those of putrefaction. Ozone, on the other hand, is fatal to the latter, but has no injurious action upon the former.

Dr. Glaser concludes that heavy winter rains and floods are very destructive to insect life.

Communications on the migrations, dates of nesting, &c., of birds may be addressed to Herr G. von Hayck, at Vienna (Secretary of the International Ornithological Congress).

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